SOCIAL SCIENCES

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INDUSTRIAL MEDICINE

The Journal of Occupational Diseases and Traumatic Surgery

August, 1941

Trauma of the Urinary Tract
— Twenty-Three Cases —

Study of Absenteeism
— in a Hat Manufacturing Plant —

Circulatory Function
— Evaluation in Extremities —

Thrombophlebitis
— of the Veins of the Lower Extremities —

Cow's Horn
— as a Corticomedullary Bone Splint —

Historical Milestones
— Isbrand de Diemerbroeck and Guilielmus Salmon —

The Railroad Employee
— With Heart Disease —

The Effect of Trauma
— in Relation to Tuberculosis, Pneumonia and Pernicious Anemia —

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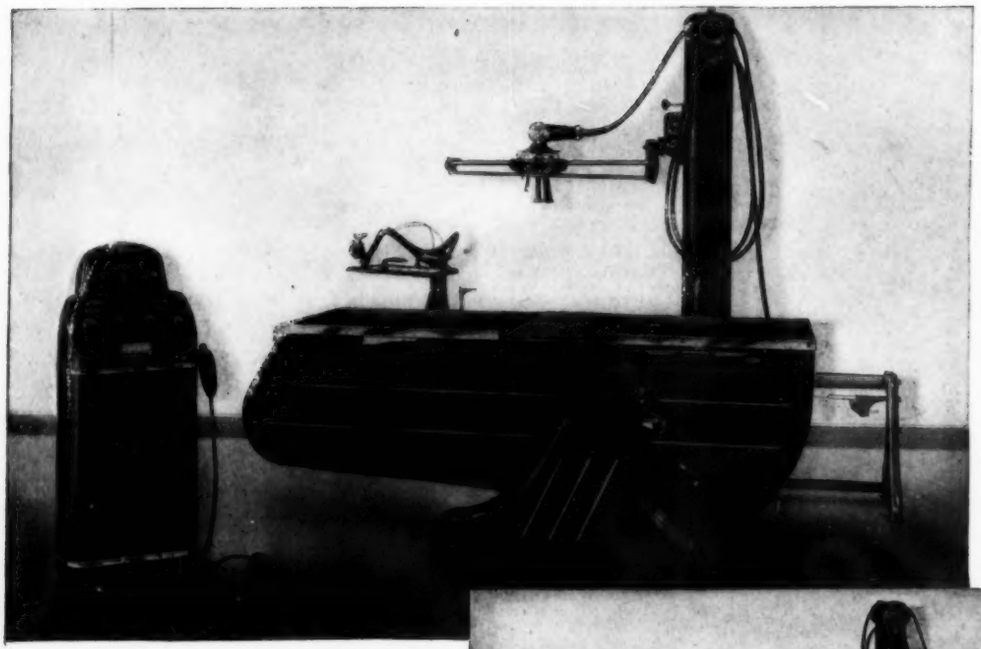

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& RAILROAD SURGERY

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INDUSTRIAL HEALTH and DISEASE:
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(In "Medical Record")

THE articles in this issue seem, more than usually, to be characterized by that quality of author interest which is so essential to reader interest. Each writer has something to say. And he says it with the effectiveness that comes from keen absorption in his subject and the authoritativeness derived from study and experience. It isn't necessary to praise any article specifically. None of them needs it; quoting our favorite author: "Praise amounts to nearest nothing where it most is earned." Three things, however, may be given special mention, as particularly notable in an issue where everything is notable. They are the three programs: (1) that of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS (page 340) which will hold its Fifty-Second Annual Meeting at Chicago September 8, 9, and 10; (2) that of the SECOND SYMPOSIUM ON INDUSTRIAL HEALTH (page 339) to be held at the Medical College of Virginia, at Richmond, September 11 and 12; and (3) that of the AMERICAN CONFERENCE ON INDUSTRIAL HEALTH (page 359) which will have its Second Annual Meeting at Chicago, November 5 and 6. We have been impressed, throughout the years, with the fact that successive programs, particularly those of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, seem to reach a high mark of importance and value which it will be impossible to excel in any subsequent year. And yet Program Committees continue to set new standards of excellence!

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The Twenty-Seventh (1942) Annual Meeting of the American Association of Industrial Physicians and Surgeons and the Third (1942) Annual Meeting of the American Industrial Hygiene Association will be held at Cincinnati, Ohio, April 13-17, 1942.

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DR. HERBERT M. LONG has been appointed Chief Surgeon for the New York Central System, with headquarters at Pittsburgh, to succeed DR. GEORGE R. WINTERS, de-

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DR. EDWIN H. PLACE, a member of the staff of the division of industrial hygiene, National Institute of Health, Bethesda, Md., has been appointed director of the division of industrial hygiene of the Alabama State Department of Health. He succeeds DR. JOHN R. CAIN, Montgomery, who resigned several months ago. DR. PLACE graduated at Detroit College of Medicine and Surgery in 1932, and has served as director of the Des Moines County Health Department in Iowa and in Midland and Dickinson Counties in Michigan.

DR. CLARENCE W. MUEHLBERGER, Chief Chemist and Toxicologist for the Coroner of Cook County until his recent resignation, has been appointd Michigan State Toxicologist.

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DR. HENRY P. WORSTELL, Columbus, Ohio, who has been assistant supervisor of the medical section of the State Industrial Commission, has been appointed supervisor. He succeeds DR. SIDNEY M. MCCURDY, Columbus, who resigned.

FROM the *Cincinnati Post*, August 2, 1941—Plans for the joint annual meeting of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS and the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION to be held here next April were outlined at a program committee meeting Saturday in the Gibson.

Approximately 1000 industrial physicians are expected to attend the meeting which will be held from April 13 to 17, 1942.

The rapid progress of American industry, accelerated by the defense program, has placed a greatly increased burden of responsibility for the health of all industrial workers upon physicians and hygienists, according to the committee. In recognition of this fact, committee members said, the clinics, conferences and scientific sessions will deal with the various aspects of the major hygienic problems of industry.

Those who attended the all-day meeting of the program committee were:

DR. T. LYLE HAZLETT, President of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, Pittsburgh; DONALD E. CUMMINGS, President of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, Denver, Colorado; DR. ROBERT A. KEHOE, Director of the Kettering Laboratory at the University of Cincinnati; DR. MELVIN N. NEWQUIST, New York City; DR. OTTO P. GEIER, Cincinnati;

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Because of its contained ingredients (chlor-iodo-camphoric aldehyde, levo-hyoscine oleinate, and menthol in an alcohol-chloroform-ether vehicle), Calmitol Ointment blocks the further transmission of offending impulses, exerts a mild antiseptic action, contributes to resolution by local hyperemia. In obstinately severe pruritus, Calmitol Liquid is recommended, except on sensitive areas or denuded surfaces.

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THE DEPENDABLE ANTI-PRURITIC

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INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC. is the new name of AIR HYGIENE FOUNDATION OF AMERICA, INC. The foundation, originally incorporated in Ohio in 1935, was reincorporated under the laws of Pennsylvania on July 23, 1941. The new name was adopted to describe more clearly the expanding activities and services of the organization. When the foundation was organized its main emphasis was on silicosis, which was the number one industrial health problem at that time. With the rapid advances in industrial hygiene and with new occupational health problems, the work has steadily broadened. A study is now under way in collaboration with the U. S. Public Health Service and the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, to help reduce sick absenteeism in heavy industries.

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Other studies include roentgen ray technics for large scale physical examinations in industry, control of toxic fumes and gases, exhaust ventilation for health protection of employees and investigations of "protector" dusts, including aluminum, to combat dust diseases. The FOUNDATION'S Sixth Annual Meeting will be held at Mellon Institute, Pittsburgh, on November 12 and 13, 1941.

MONTANA has a new law which provides for welfare payments of not more than $30 a month to residents of that state who are disabled by silicosis. The plan has no relation either to workmen's compensation or to insurance. To be eligible for benefits, an applicant must be totally disabled as a result of silicosis; must have been a resident of Montana for 10 years next preceding the date of application; cannot be an inmate of any public institution except the State Tuberculosis Sanitarium, in which case the benefits are payable to his wife and children; must not be receiving either workmen's compensation benefits or Federal-State old-age assistance, or both, in amount equal to or in excess of $30 a month. The source of funds for benefits is de-

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TO provide an organization, not for pecuniary profit, in which all agencies and societies, both medical and lay, concerned with the problems of industrial health can hold membership and can meet together in conference for the study, discussion and careful consideration of all industrial health problems and procedure; to engage in scientific research to determine the cause, nature, prevention and cure of diseases and injuries of occupations; to assist in establishing and supervising industrial health clincs to serve small industries; to establish and maintain hospitals which will furnish facilities for the care, treatment and study of occupational injuries and diseases; to make surveys of

scribed as "such appropriation as may from time to time be made." This is the first attempt made in any one of the states to impose the cost of an industrial disease directly upon the public instead of upon industry. Silicosis, it should be noted, is a disease which is always due to work exposure. It is not a disease to which the general public is exposed. — *Labor Standards*, May-June, 1941.

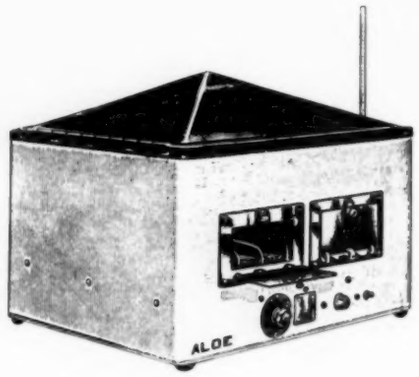
IN warfare as now waged, the mental and manual work of 12 (to state the proposition conservatively) is necessary to maintain one effective combatant in the field. Loss of working time by indispensable skilled craftsmen then must be regarded as wartime casualties equal in importance to those which occur in actual combat. The same careful mobilization of medical and hygienic resources will be required to keep them under control."—DR IRVIN ABELL, in *J.A.M.A.*, July 19, 1941.

THE reluctance of men unfit for military service to seek medical aid has caused COL. SAMUEL J. KOPETZKY, Chief Medical Officer of New York City Selective Service, to recommend a city-wide campaign to encourage treatment, it was announced by COL. ARTHUR V. MCDERMOTT, Director of New York City Selective Service. COL. KOPETZKY reported that a two-month experiment had been conducted by the Selective Service in the area of a local board in Queens County where it was made possible to help rejected registrants to obtain medical aid

New Serological Baths

for the

Kahn Verification Test



With Built-in Pipette Compartments. These new serological baths have been especially made for use in the Kahn Verification Test, according to the author's specifications. Two types are offered: an electric Warm Bath for use at 37° C., (which may be used for temperatures up to 60° C.), and a Cold Bath for use at 1° C. with ice. The Warm Bath consists of a well-insulated inner chamber measuring 16 x 19 inches, with a perforated shelf for accommodating serological tube racks in the usual manner. The shelf rests on two pipette compartments with doors opening on the exterior front of the bath. A precision hydraulic thermostat with an expansion element in conjunction with a positive-acting magnetic switch maintains the temperature within ½° C. No micro switches are necessary for the thermostat employed. The Cold Bath is similar in all respects to the Warm Bath, but has no heating elements. In use, cracked ice with water is placed over the removable inner shelf causing cold water to surround the pipette chambers.

JL4-994—Kahn Verification Serological Water Bath, for 37° C., complete with electric immersion heating element, thermostat, etc., for 110-120 volts A.C. or D.C., Each . . . **$140.00**

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1831 Olive Street St. Louis, Missouri

American Conference on Industrial Health
(Continued)

industrial medical services and recommendations for their improvement; to solicit, receive and administer funds for any purpose that will advance and/or improve industrial health; to establish undergraduate and/or post-graduate courses in industrial medicine and surgery and/or to cooperate with medical schools and industries in maintaining such courses; and to use all those means, which from time to time, may seem to it wise, for the advancement of industrial health.

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easily for curable defects. There was no marked response. "More positive methods are evidently necessary. The organized medical profession has contended for a long time that many persons would refuse the benefit of medical care even were it put upon their doorsteps. In acute illness, everyone seeks relief. But during the after-effects, where the affliction is not disabling and if employment is still possible, reluctance has been the rule. . ." Something for the proponents of socialized medicine to get around!

OFFERING special priority to the health problems of manufacturers engaged directly or indirectly in defense work, the Division of Occupational Hygiene of the Massachusetts Department of Labor and Industries recently sent a bulletin describing its services to industrial establishments in the state. The bulletin states: "The great increase in manufacturing activity incident to the national defense program is bringing new health problems to industry and aggravating

—Continued on page 362.

"GIVE ME SUDS . . . LOTS OF 'EM"

Yessir! A fellow's gotta have his lather!

Ever watch a workman wash? He'll take repeated helpings of soap until he has a satisfying lather. Suds and workmen go "hand in hand". . . That's one of the keys to your washroom economy!

Supply rich-lathering PAX Skin Cleanser to your employees. They'll soon learn that a small amount is sufficient to lather quickly and cleanse thoroughly. No wonder PAX costs so little . . . less than ¾ cents per man, per week.

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That's HEAT-FAG — the enemy of production. To labor, it makes the job seem harder, more tiring. To management it means lowered efficiency, mistakes and a sag in production.

The remedy is simple and inexpensive . . . Morton's Salt Tablets in sanitary dispensers at all drinking fountains. Workers welcome this contribution to their comfort and welfare.

AVOID HEAT-FAG USE MORTON'S SALT TABLETS

Dispensers
500 Tablet size
$3.25
1000 Tablet size
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Tablets
Case of 9000
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Place Morton Dispensers At All Drinking Fountains

Morton's modern dispensers deliver salt tablets, one at a time, quickly, cleanly, and without crushing or waste. Sanitary, easily filled — durable and dependable.

Morton's salt tablets contain the most highly refined salt, pressed into convenient tablet form, easy to take with a drink of water. They dissolve in less than 40 seconds after swallowing.

Order dispensers and tablets direct from this ad . . . a small investment that pays big returns.

FREE.. write on your firm letterhead for a pocket size sample tube of MORTON'S SALT TABLETS, and new folder, "Heat-Fag and Salt Tablets."

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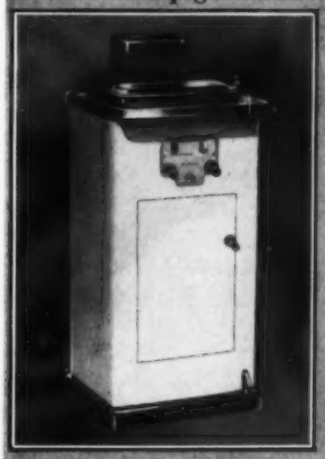

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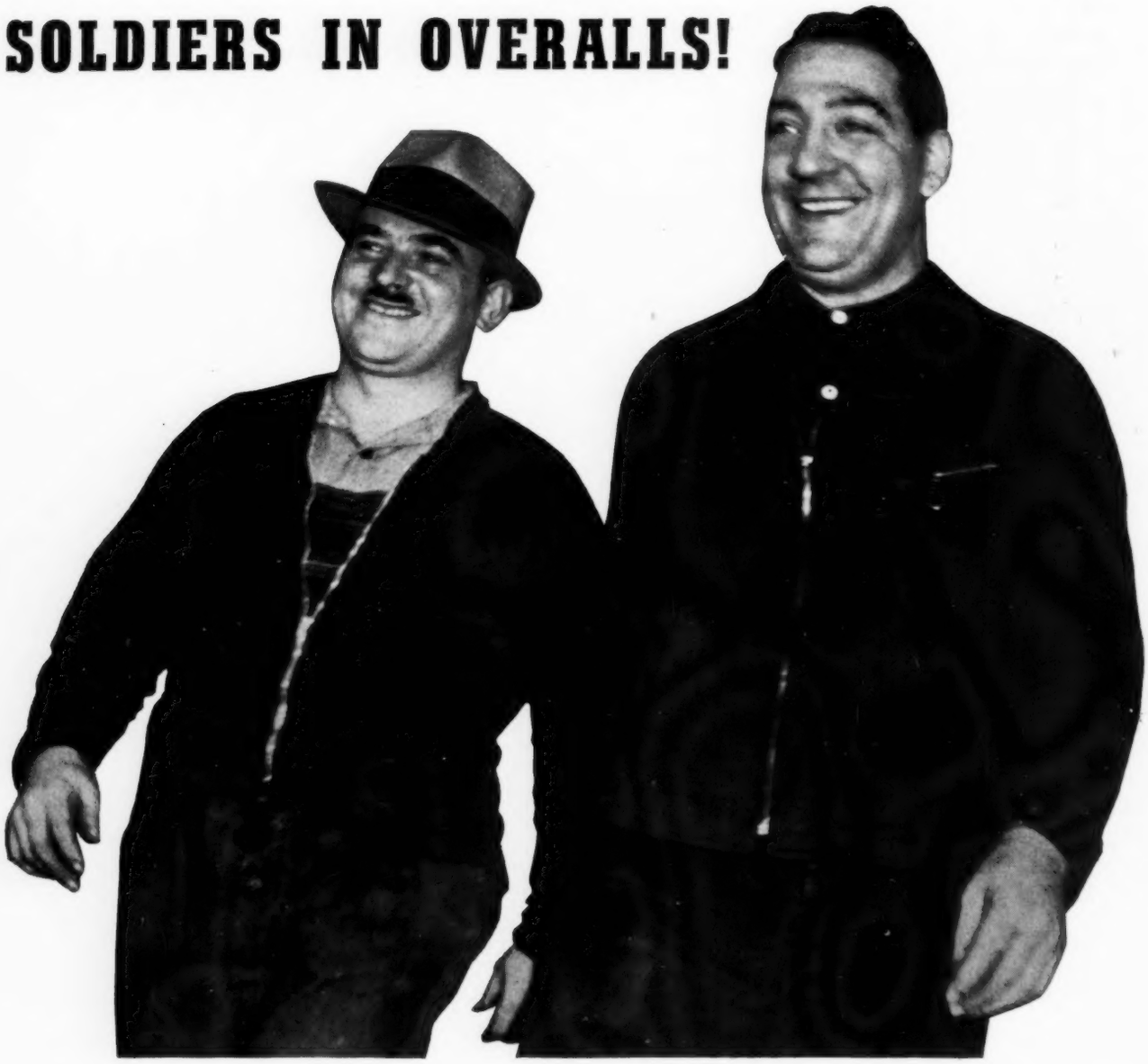

Guard Them from T. B. with Photo-Roentgenography

WHEN twelve men are needed in the factory to keep one man in the field, and when loss of working time is as serious as a casualty in battle, industrial workers nowadays are as much a part of national defense as the khaki-clad boys in the training camps.

Charged with the responsibility of protecting its "soldiers in overalls" from tuberculosis — two and a half times as great in industry as it is generally — vigilant industrial medical directors are turning to large-scale case-finding surveys during pre- and post-employment examinations.

And they are discovering an ideal case-finding medium in economical, fast, reliable 4 by 5 photo-roentgenography — photography of the fluorescent chest image on a 4 by 5 inch x-ray film. Economical enough to cost only a few cents a person for films and materials, this clinically-tested procedure is reliable enough to have proven within 2% as accurate as conventional roentgenography for case-finding purposes.

Tests of the reliability of 4 by 5 photo-roentgenography have been reported in accredited medical literature, and reprints of these as well as a catalog describing G. E. equipment for photo-roentgenography are available from Dept. D18.

GENERAL ELECTRIC X-RAY CORPORATION

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This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain articles, news items, reports, digests, and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

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Trauma of the Urinary Tract

—Twenty-Three Cases—

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ALTHOUGH textbooks and the literature indicate a rarity of injury to the urinary tract because of the peculiar or well protected anatomical relationship of the urinary organs, I have observed that such trauma is not so scarce if one considers the number of cases with complications and sequelae that often may be reasonably attributed to a single act of trauma.

Available statistics reveal primarily those cases that are seen in the hospital, yet many incipient cases are treated at home. Inquiry at the Department of Labor of the State of New York regarding data of trauma to the urinary tract among industrial workers reveals the fact that records of the diagnosis of such injuries are not maintained. I have also been unable to obtain any statistics in this connection from the Department of Labor in Washington. Mortality tables are misleading, because urinary tract trauma may be incidental or secondary to other injuries from which the patient died.

In the annual report of the Department of Hospitals of New York City for 1939 (with 284,256 admissions), there were 9,115 genito-urinary cases (or 3.8%), while all traumatic cases (including orthopedic) amounted to 25,964 cases (or 10.9%). At Cumberland Hospital in Brooklyn (318 beds) there is an average admission of 9,000 cases per year. A study of cases for the past 10 years reveals 23 in which there was definite trauma to the urinary tract. No doubt such paucity in comparison with other trauma is due to the fact that injury to the urinary tract is so frequently secondary to other traumatic conditions in the same person and the cases are, therefore, classified according to the primary injury.

In analyzing these 23 cases (some of these were under the direct observation of the urology department and some were cases in which urological consultations were requested by the surgical division), I found:

1. Seventeen cases were males and six were females.
2. All kidney cases (nine) were treated conservatively.
3. The left kidney was involved in five cases and the right kidney in four instances.
4. Three out of the five cases of rupture of the bladder also had pelvic fractures.
5. In all of the cases, there was hematuria.
6. There were three deaths in this series. One died within 24 hours from shock (85 years old), another died several weeks later following an open reduction, and the third died at the end of 17 days with postmortem findings of a thrombophlebitis of the bladder and a ruptured urethra. This last case had a retention catheter which was pulled out by the patient on the fourth day. A suprapubic cystotomy was done on the fifth day.

In this discussion, I am considering trauma of the urinary tract, irrespective of instrumentation, surgery, or military duty. The traumapathies most frequently seen in the majority of accidents are: contusions, lacerations, ruptures, displacements, and the associated complication of infection.

For the sake of simplicity, it might be well to divide the urinary tract into two functioning units (as suggested by Burghela and Streja[4]):

A. The upper or excretory system (kidneys and ureters).

B. The lower or reservoir system (bladder and urethra).

"A"—Upper Urinary Tract

KIDNEY: Campbell[6] states that "in children, kidneys are more frequently injured than any other urinary organ." Hermann[13] assigns greater frequency of kidney trauma in children because there is a smaller fatty capsule here. In the adult, the majority of cases occur in the male (90%) due to greater exposure and the fact that

there is a greater amount of fat and a wider and higher iliac crest in women (Squire[32]). Most writers report a higher incidence of right renal trauma because of the relative fixation of the right kidney by the liver. Despite the slightly lower position of the right kidney on account of the liver, the left kidney is somewhat longer and narrower (Gray's Anatomy[11]). The longer pedicle of the left kidney may explain the somewhat greater upward and downward motion, and on this account possibly escapes trauma more often than the right kidney. In the small series of cases reported, however, I have found the left kidney involved in five instances and the right in four cases.

In an article, entitled "Traumatic Abdomen," Bancroft[1] opens his discussion with this statement: "a normal appearing skin frequently covers a multitude of sins." In some measure, this observation is applicable to trauma of the kidney since the severity of kidney damage is not always proportional to the extent of the external injury or external signs.

The lesions of kidney injury may be classified as mild, moderate, or severe. In the first group, there is a tear in the fatty capsule. The resulting hemorrhage in the perirenal tissue either absorbs or organizes. The next group is that of an actual contusion to the renal parenchyma and this is followed by hemorrhage with either absorption, scar formation or infection. Beyond the simple contusion is the actual rupture with extravasation in the perirenal tissue or in the kidney itself. Fortunately, the severe rupture involving the kidney parenchyma and capsule is not so common. When it is extensive, there is a fibrosis with no regeneration. The most severe types of trauma (and the rarest) are the actual fragmentation of the kidney with a rupture of the peritoneum or a ruptured pedicle with extravasation.

What happens after moderate and severe injury is listed by Rolnick[8] as:

1. Scar tissue only.
2. Perirenal infiltration.
3. Perinephritis causing distortion and compression.

In studying the repair of kidneys following trauma, Wesson[37] found that the tubules and glomeruli do not regenerate and that the gap between the two edges of the injury is filled in by interstitial connective tissue, forming a scar. In an experimental study of renal function and structural changes following kidney trauma, Powers[26] used male rabbits and traumatized the kidney by striking it with a pestle. He produced moderate and severe trauma causing extensive hemorrhage. The animals used were killed on the second day. His conclusions were that the impairment of renal function following trauma of moderate severity is transient and due to a degeneration of the tubules, subcapsular and parenchymatous hemorrhage, edema, and infarction. The tubular epithelium, however, regenerates rapidly and fast functional recovery takes place. On this basis, he further concludes that the majority of patients with unilateral renal injury may be treated conservatively with the exception that the injured kidney will recover sufficient function to be a useful and serviceable organ.

The complication of infection is obviously a major factor in the later sequelae of kidney trauma. Stearns[33] reports a case that was first considered a simple back injury and subsequent study proved a renal contusion with secondary infection. Three years after the accident, there was a deviation of the course of the ureter and an obliteration of the lower calyx.

Many urologists report cases of hydronephrosis several years following trauma and these changes are evidently due to scars or fibrous tissue.

Stirling and Lands[35] list secondary complications as stones, pyelonephritis, hemorrhage, perirenal suppuration, and atrophy due to interference of the blood supply. The vascular damage may later cause an ischemia followed by hypertension. Many cases of the Goldblatt type that have a traumatic etiology are problematic, I believe.

Lazarus[19] reported a case of renal calculus developing 13 weeks after an injury, yet Kessler[16] in his book on Accidental Injuries says that "this condition may be dismissed because it can never be caused by injury." Sklarz[31] and Cabot[5] report post-traumatic calculi around a coagulum.

The subject of displacement of the kidney is a significant one inasmuch as it is frequently a medicolegal problem. Lasher[18] denies such a possibility due to trauma, while others maintain that it may result from even a simple abdominal strain. In 200 cases of movable kidneys, O'Conor[23] found 12 that were classified as traumatic. In this type of injury, the lower end of the layers of fascia of Gerota are stretched or are separated. While such a process is usually a slow one, it is conceivable for displacement to occur after an injury, especially in those with the body type (tall, slender, and flat-chested). Cabot notes that it is remarkable that the severe injuries of the kidney rarely produce displacement. The cases I have encountered were not subjects of severe trauma and, incidentally, all were females.

Aside from the clinical findings for diagnosis, there appears to be a diversity of opinion among urologists with respect to the value of the intravenous pyelogram. Peacock[24] feels it is unsatisfactory because shock and low blood pressure accompanying kidney injuries retard excretion. This contention is also shared by Marquardt and Cook,[21] Sargent,[29] Foulds,[10] and Shannon. Undoubtedly, excretion urography has its limitations. One may get adequate information from this study and yet it may be misleading particularly when there is negative evidence. Recently, I had occasion to see a traumatic case that had an intravenous pyelogram showing a calcific shadow in the region of the right kidney and no excretion from that side. The attending urologist made a diagnosis of a renal calculus with infection and contemplated an operation. This diagnosis was shown to be an error, when, on retrograde pye-

lography, the right kidney was found to be normal and the shadow noted was located outside of the renal area.

Herman[12] warns against cystoscopy and retrograde pyelography in kidney injuries because of possible infection. Farman[9] states that he could find no cases in the literature of known infection or of increased hemorrhage caused by cystoscopy in kidney injuries.

In this controversey, the course of procedure suggested by Macnish[20] seems prudent. He recommends intravenous pyelograms for the majority and, if doubt exists, retrograde urography. With the use of the newer drugs and sterile technique, it seems that such retrograde pyelography would be less hazardous than the handling of a serious case without such assistance. Obviously, bilateral retrograde pyelography is contra-indicated in kidney injuries because of possible supression from the uninjured side. If the ureters are not to be catheterized, much information is available by chromo-ureteroscopy.

In the matter of treatment, one must follow his clinical judgment as it is rather difficult to establish any standard rules applicable to all cases. Conservative treatment serves the majority of cases best, unless there be definite indications for surgical intervention.[2]

The questions of rest and absence from physical activity have not been emphasized enough. It is the opinion of O'Conor that all kidney injuries merit a minimum of two weeks of bed confinement and from four to eight weeks absence from physical activity. I believe that Moorehead's[22] admonition to "REMEMBER TO GIVE THY PATIENT REST ON THE DAYS FOLLOWING INJURY" is quite apropos in these cases.

URETER: In a report of 50 cases of ureteral injury by Rusche and Bacon,[28] there were none due to external trauma. This is the largest number of cases of ureteral injury so reported and does not include the rare injuries from stab and gun-shot wounds. No doubt, the ureter is not vulnerable because of its size and anatomical protection.

"B"—Lower Urinary Tract

BLADDER: The common lesions here are the simple contusions, partial rupture, and complete rupture.

While the bladder (as well as the urethra) may be very tolerant to instrumentation, the converse may be true in connection with external trauma. It is generally agreed that the normal bladder is ruptured by trauma only when it is full. When so distended, it is an abdominal viscus and therefore susceptible. The exception, of course, is the rupture of the bladder caused by a fractured pelvis (Stirling[34]).

As in the case of upper urinary trauma, the majority of bladder injuries are seen in the male. The fact that the bladder lies more completely in the pelvis in females may account for this observation. Another factor may be the presence of the uterus in back of the bladder and this could act as a cushion in absorbing some of the force of a blow.

The simple contusions do not warrant any extensive discussion since all clear up without any sequelae of consequence except for a possible cystitis. This condition is amenable to palliative treatment.

Occasionally there are cases of incomplete ruptures of the bladder and these are sometimes referred to as "subperitoneal ruptures." The symptoms are milder than in complete ruptures. They clear up spontaneously as in the simple contusions or may require an indwelling catheter.

The early diagnostic features in the actual ruptures are hematuria and urinary difficulty. Of course, the history is of vital importance. Further confirmation of the diagnosis is accomplished by the intravenous pyelogram or cystogram (using air or a non-irritating sterile fluid).

The subject of air cystograms has been one of controversey among many urologists. Ritter[27] and Cubbins feel that it is hazardous while Kahle,[15] Beacham, Culver[7] and Baker report no complications from air cystograms. Aside from indicating a rupture of the bladder, the air cystogram will also show whether the rupture is intraperitoneal or extraperitoneal.

Whether or not the rupture is extraperitoneal or intraperitoneal or even if the diagnosis is doubtful, all concur that the proper treatment is surgery —early surgery. This is the type of injury wherein procrastination with respect to operation is in direct proportion to morbidity and mortality. Those cases that are operated upon early recover.

The primary complications of bladder ruptures are extravasation and infection. Here, as elsewhere, extravasation calls for early and adequate drainage.

An admonition worthy of repetition is the avoidance of too early instrumentation following bladder drainage.

URETHRA: The most frequent injuries here (as in the bladder) are contusions, incomplete tears, and complete ruptures.

Senger and Johnson[30] note the rarity of injury to the pendulous portion of the urethra. This infrequency is also mentioned by others for the membranous urethra. The most common site involved in tears and ruptures is the bulbous portion. The fact that the bulb is thin and lacks great protection may influence its liability to injury.

In simple contusions without rupture, an edema results. At times, this may even cause an acute retention. Here, an indwelling catheter for a few days accomplishes a cure by the abatement of the edema.

The way in which ruptures of the urethra are sustained will vary according to the industrial pursuit or activity at the time. It is therefore apparent that the history is of great significance.

In addition to the clinical picture (difficulty or inability to urinate, oozing of blood from the urethra, and swelling—depending on the site of laceration), a significant diagnostic sign of rupture may be the inability to catheterize the urethra. If, however, a grossly clear urine is obtained, a serious urethral trauma may be precluded. In

connection with the subject of catheters, I feel that a soft rubber type should be used. Indeed, a stiff or metal catheter is objectionable because further trauma is produced. In the use of indwelling catheters, Hornaday[14] advocates small ones (16 to 20 F.).

Thompson,[36] in discussing the treatment of urethral injuries, states that in all cases a suprapubic cystotomy should be done regardless of whether a catheter has been passed or not. However, the splinting of some urethral tears by an indwelling catheter appears to be adequate treat-

GENITO-URINARY TRAUMA

ANALYSIS OF 23 CASES AT CUMBERLAND HOSPITAL — 1930-1940

Case	Sex	Age	Hospital Days	How Injured	Diagnosis	Other Injuries	Shock	Hematuria	Treatment	Result
1.	M	37	11	Thrown about in auto—skidded.	Contusion of Right Kidney	Fracture of 3 ribs and 2 transverse processes.	Yes	Yes (5 days)	Symptomatic I. V. pyelog. negative.	Improved
2.	M	39	5	Fell down steps.	Contusion of Left Kidney		No	Yes (3 days)	Symptomatic Retrograde and I. V. pyel. negative.	Improved
3.	F	10	38	Fell over ladder.	Contusion and Laceration of Left Kidney		No	Yes (17 days)	Symptomatic I. V. pyelog. showed filling defect.	Improved
4.	M	14	11	Fell against bench.	Contusion of Right Kidney		Yes	Yes (4 days)	Symptomatic I. V. pyelog. showed insufficient f.	Improved
5.	M	43	28	Automobile collision.	Contusion of Left Kidney	Fracture of the nose and 2 ribs Hemothorax (1).	No	Yes (14 days)	Symptomatic	Improved
6.	M	11	10	Struck by automobile.	Contusion of Right Kidney	Multiple contusions.	No	Yes (1 day)	Symptomatic	Improved
7.	M	30	3	Struck side of tank while diving.	Contusion of Right Kidney	Has Epilepsy.	No	Yes (3 days)	Symptomatic	Transf. to Kings Co. Hosp.
8.	M	29	11	Fell from a building—fighting fire.	Laceration of Left Kidney		Yes	Yes (4 days)	Symptomatic	Improved
9.	F	40	2	Automobile collision.	Rupture of Left Kidney	Lacerations of left arm and left breast.	Yes	Yes (2 days)	Symptomatic	Transf. to Beth Moses Hospital
10.	F	85	1	Automobile collision.	Rupture of Bladder	Fracture of pelvis.	Yes	Yes	Symptomatic	Died (shock)
11.	M	40	74	Run over by truck.	Rupture of Urethra and Bladder (extra peritoneal)	Fracture of pelvis	Yes	Yes	Supra-pubic and external Urethrotomy.	Improved
12.	F	21	19	Automobile collision.	Laceration of Bladder (intra peritoneal)	Fracture of pelvis and left 8th rib.	Yes	Yes (4 days)	Suprapubic	Improved
13.	M	32	32	Stabbed in abdomen.	Rupture of Bladder	Stab wounds of chest and right hand.	Yes	Yes	Suprapubic and Retrogr. Urethrotomy (old G. C. stricture)	Improved
14.	M	37	36	Stabbed in abdomen.	Rupture of Bladder		No	Yes	Suprapubic	Improved
15.	M	25	1	Kicked in the abdomen.	Contusion of Bladder		No	Yes	Symptomatic	Improved
16.	M	53	2	Fell on abdomen.	Laceration of Urethra		No	Yes	Symptomatic	Improved
17.	M	16	53	Run over by truck.	Rupture of Urethra (posterior)	Fractures of pelvis and L. femur.	Yes	Yes	Suprapubic	Died of shock foll. open red. operation
18.	F	46	5	Fell on ice.	Rupture of Urethra		No	Yes	Indwelling Catheter	Improved
19.	M	18	2	Fell on bars.	Rupture of Urethra		No	Yes	Symptomatic	Signed release.
20.	M	55	17	Fell between rungs of a ladder.	Rupture of Urethra		Yes	Yes	Catheter for 4 days—Suprapubic on 5th day.	Died thromboph. of bladder and torn urethra (membran.)
21.	F	15	10	Fell on a picket fence.	Laceration of Urethra	Lacerated hymen.	No	Yes	Symptomatic (Vagina packed).	Improved
22.	M	36	1	Struck right groin on an elevator shaft.	Contusion of Urethra	Swelling of base of penis.	No	Yes	Symptomatic	Signed release.
23.	M	33	12	Fell down a ladder—15 years ago.	Post-Traumat. Stricture of Urethra	Rt. testicle removed after original injury.	No	No	Dilatation	Improved

ment. While conservative treatment seems desirable, it is good practice to resort to surgical repair before the tissues become devitalized.

The early complication of extravasation requires incision and drainage over such areas of extravasation. The later and most common result of urethral lacerations is "stricture." Despite effort at obtaining perfect continuity of the urethra, the loss of cellular elements of the tissue plus the productive inflammation brings about an increase of connective tissue fibres. The end result is a scar. These strictures may follow within four to six weeks in contrast with the postgonococcal strictures that do not appear for a much longer period. It is apparent that post-traumatic narrowing of the urethra should be dilated early after the acute experience. Dilatations should continue indefinitely—some believe for the rest of the injured's life.

Some of the uncommon sequelae noted in the literature are profound mental reactions after severe injuries of the genitalia (Pierce and O'Connor[25]) and impotence as a result of periurethral scars and diminished muscle tone.

It is evident that some urinary tract traumapathies will present problems from a medicolegal aspect. The appraisal of the role of an original trauma with later sequelae should not be a serious difficulty if the involved pathology is borne in mind. To be sure, there will often be a wide difference of medical opinion as to the relationship of certain disease to a particular injury. It should be the aim to do justice to all concerned by giving mature consideration to the injury, the immediate sequence of events, and to the underlying pathology. In this way, bizarre and far-fetched claims may be refuted and legitimate disabilities may be validated by unbiased and unprejudiced testimony. In this connection, Koontz[17] has suggested the use of uniform standards to valuate disability due to injuries. In cases of injury to the urinary tract such standardization does not appear feasible.

As an illustration of a handicap to urological diagnosis in litigated cases, Brosnan[3] refers to a recent judicial ruling as follows: ". . . . in an action to recover damages for personal injuries, the defendant applied to the court for an order directing a female plaintiff to submit to a physical examination which would include, as a part thereof, a cystoscopic examination. As a part of the application, defendant submitted the affidavit of a medical expert which set forth that the said physician had never known of a case in which, from a cystoscopic examination, there had 'been any very harmful, serious or fatal results nor . . . . a fatality resulting simply from a cystoscopic examination,' and furthermore that such examination 'cannot be compared . . . . in seriousness with a major operation.'

"The motion was opposed on behalf of the plaintiff, and the papers in opposition included an affidavit of another physician, who, on the contrary, contended that a cystoscopic examination was 'a major operation . . . . most painful, and . . . . has been known to cause death'. The court at Special Term denied the application so far as the same included a request for an order requiring a cystoscopic examination. An appeal was taken to the Appellate Division of the Supreme Court for the Fourth Judicial Department, and that court, upon the record before it, refused to interpret the statute so as to permit the particular examination sought. In so ruling, the court said, in the course of its opinion:

" 'In asking for a cystoscopic examination of plaintiff the appealing defendants are asking us to go much further than our courts have ever gone in subjecting a party to physical pain and danger to health'."

Conclusions

TWENTY-THREE cases of trauma to the urinary tract were revised by the writer. The injuries involving the kidney were treated conservatively while the majority of cases of the lower urinary tract required early surgery.

2. Our present urological refinements for diagnosis may be used with safety in most cases of trauma.

3. Reasonable sequelae, based on definite pathological changes following trauma to the urinary tract are noted.

4. The causal relationship between injury to the urinary tract and sequelae should be established by the history, clinical course, and a clear conception of the pathology of the trauma.

5. The writer suggests a modification in the law permitting latitude in the use of methods for diagnosis in medicolegal cases as an aid in determining the validity of claims of trauma to the urinary tract.

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Study of Absenteeism

—In a Hat Manufacturing Plant—

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MANY studies have been conducted during the past few years on absenteeism in industry, and manufacturers have now become cognizant of the enormous losses sustained on account of the loss of working time as a result of illness. It has repeatedly been demonstrated that the time lost because of non-occupational diseases exceeded by far the time lost as a result of injuries.

It was thought that a study of absenteeism in a large felt hat industry might be of value in furthering knowledge along these lines. The plant studied here employs an average of 2200 workers of both sexes. The ages range from 16 to 65. This type of manufacture is not classed among the very hazardous. The physical working conditions are of a high grade. A plant nurse is constantly present, and a plant doctor makes daily visits to the factory.

The absences studied here are those of three days or over and under 56 days. The records used were those of the Employees Benefit Association, to which all employees automatically belong. The period studied is from May 1, 1940, to May 1, 1941. Diagnoses were furnished by physicians' certificates presented by the employees upon collecting their benefit payments. Maternity cases were not listed here, nor were absences under three days or over 56 days duration. Both occupational and non-occupational illnesses were studied.

The total number of workers absent was 820. Of these, 497 were male and 323 female. Several were absent on more than one occasion, thus bringing the number of absentees to 855.

The accompanying table lists the causes of absenteeism together with the number of absentees and the man-days lost due to each. Under "miscellaneous" are included varicose veins, asthma, chicken-pox, alcoholism, etc. A study of the figures corroborates the finding that non-occupational illnesses are a more serious cause of lost time than illness due to work.

ILLNESS	No. of Absentees	Man-Days
1. Grippe or influenza	341	2653
2. Major operations	32	1178
3. Minor injuries, minor sprains, minor infections	86	1013
4. Fractures, severe injuries	17	658
5. Tonsillitis, colds, and related respiratory infections	89	547
6. Diseases of heart and blood vessels	22	525
7. Gynecological operations	15	511
8. General debility and "nervous breakdowns"	13	412
9. Neuritis and neuralgia	27	402
10. Pneumonia and pleurisy	13	351
11. Back sprains and back injuries	30	351
12. Skin diseases	20	253
13. Gastro-intestinal cases, including ulcer	28	248
14. Tonsillectomy	17	194
15. Eye, ear and nose diseases	20	182
16. Arthritis	6	169
17. Rectal diseases	6	152
18. Dental cases	10	84
19. Miscellaneous	38	530
20. Undetermined	23	520
Total	855	10,933

The average annual number of days lost per worker was 12.7. According to the report of Dr.

A. J. Lanza, 8+ days per male and 12+ days per female wage earner is the average toll paid to disabling sickness. Actually the loss to the industry is greater, since absences under three days and over 56 days were not computed.

It is clear from the above study that further measures to improve the general health of the worker are necessary in order to reduce absenteeism due to non-occupational illness.

Evaluation of Circulatory Function in Extremities

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School of Medicine, University of Pittsburgh, The Falk Clinic, and Presbyterian Hospital

THE average pre-employment examination, although reasonably complete, rarely includes an analysis of the function of the peripheral vessels. Although this statement may be construed to mean that this subject is all important, it is indeed a fact that the economic loss is great as a result of this disability. Many methods of treatment have been and are being suggested, but few distinct means of measuring the results of therapy have been advanced in recent years.

Peripheral vascular diseases occur in and out of industry, and the present drive for better health would point to some means of preventing further disability of skilled workers. Further, there is normal deterioration of humans from the fourth decade, and it is important to know the condition of peripheral circulation in these individuals. On the other hand, certain persons may be afflicted with some type of vascular disease, wherein walking or standing is not tolerated. Thus industry could possibly be deprived of the services of an efficient worker, who may, at the same time, incur greater debility. Extremely high or low temperatures are also deleterious to certain vascular deficiencies, but the normal individual may tolerate these conditions with no ill effects. Here again is another example where a careful method of analysis may prevent either illness to the patient, deprivation of his services, or an added burden to industry in its rapid strides to increase production.

Our method of examination is based on the physiological researches of Dr. G. N. Stewart,[1] who measured blood flow in terms of heat transfer from the extremity to water of known temperature, volume and weight. This test is definitely feasible, because there are fewer variables, and the results should therefore be more accurate.

From a diagnostic standpoint, the oscillometer and the skin temperature thermocouple enjoy widespread popularity, but since the values obtained are only relative, the instruments are subject to errors through no fault of mechanical design.

In the oscillometer, the results are based on the plethysmograph, which is ideal for a laboratory instrument, but may prove somewhat inaccurate because of muscle tone, the size of the limb, the state of nutrition, etc. Therefore, data can be misinterpreted, since slight variations in environment, dry and wet bulb temperatures, relative humidity, state of mind, lack of rest, etc., are not taken into consideration.

The skin thermocouple, on the other hand, indicates only the temperature of the surface at a particular point which may be drastically altered by environmental conditions previously mentioned. The thermostatic control of the human body is extremely sensitive, and any changes resulting from the environment may affect the accuracy of surface temperatures. To that end, we have undertaken a comparative study of three methods of circulatory function in 121 patients, and the results are herewith submitted without any recommendation for any particular one.

In the laboratory of the Department of Industrial Hygiene, Falk Clinic and Presbyterian Hospital, these investigations were conducted on patients whose occupations varied from the unemployed and retired, to almost every walk of life. Previously, at the School of Medicine, volunteer students and others presumably normal, were examined and the results were comparable to those of Dr. Stewart, indicating that the technics were similar. The subjects at Falk Clinic were taken largely from the diabetic and medical services, in addition to any patients who were willing to cooperate in this study. A room was provided with an air conditioning system to maintain standardized conditions of 75° F., dry bulb, with an average relative humidity of approximately 60%. All the succeeding observations were made under approximately the same conditions. The usual histories,

Fig. 1.

Presented at the Twenty-Sixth Annual Meeting of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, Pittsburgh, May 6, 1941.

including family, past medical, etc., and physical examinations, including the usual routine as provided by any medical service, were recorded.

All data obtained by two measurement methods were made in the dependent, horizontal and elevated positions to determine the effect of gravity. The temperature readings were derived by using a standard thermocouple, and the oscillometric readings were made on a recording device to obtain permanent records, and to eliminate human errors. The calorimeters (Fig. 1) were copied from the original models of Dr. Stewart, now in possession of Dr. J. M. Rogoff,* at the suggestion of Dr. C. C. Guthrie.** The oscillometric and skin temperature methods require no explanation, but the calorimetric technic will be briefly described:

The subject places his feet or hands in a vessel containing water at approximately 30°C. for 15 minutes, which we will designate as the "stabilizing bath." At the end of that time, the part is swiftly transferred with a minimum of exposure into a calorimeter containing water at exactly the same temperature. Temperature readings in .01°C. were made several times within 20 minutes on Beckmann thermometers. The following formula is used to calculate the flow of blood through the tested extremity:

$$Q = \frac{H}{T-T'} \cdot \frac{1}{S}$$

Q = the quantity of blood flowing through the hand during the period of observation.
H = the heat given off to the calorimeter and includes also the unknown loss during the period of observation, as well as the water equivalent of the calorimeter and of the part tested.
T = the temperature of the arterial blood. Stewart found this to be 0.5° below the rectal temperature, or equivalent to the mouth temperature.
T′ = the temperature of the venous blood — i.e., the mean temperature of the calorimeter.
S = the specific heat of blood or 0.9.

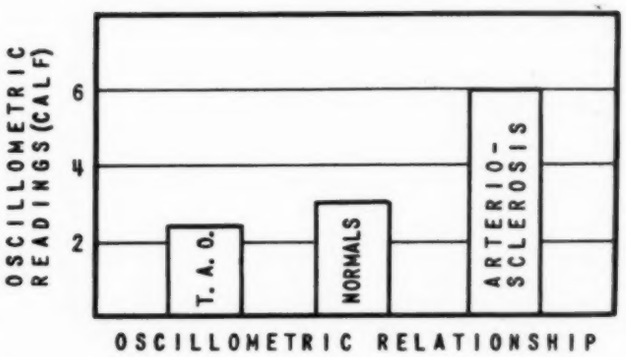
The volume of the tested part was measured by the displacement of water and the flow of blood recorded in grams of blood per 100 cc. per minute.

The observations relative to the peripheral circulation were made on 121 subjects. Of this group there were 55 normals, 10 were asymptomatic with relation to peripheral vascular disease, though not normal with regard to other systemic disorders. Eight cases were diagnosed thrombo-angiitis obliterans, and 31 as arteriosclerotic vascular disease. The remainder consisted of varicosities, neuritis, etc., who were examined at the request of clinic physicians.

Discussion

THE dorsalis pedis pulsation has been used as a criterion of the presence or absence of vascular disease, but it is interesting to note that this finding is not constant in any of those conditions under discussion. In the arteriosclerotic subjects examined, this pulsation was palpable in over 50% of the cases, and the posterior tibial in equally as many. One may conclude that the absence of either pulse does not invariably mean that vascular disease is present; conversely, the presence of the pulsation does not entirely rule out the possibility of a vascular lesion. Here too, the oscillometric findings were not entirely reliable, because the readings were higher than those of normal subjects. In a paper not yet published,[2] the average oscillometric index on normal and asymptomatic subjects was 5.7, and in a series of 51 observations on arteriosclerotics the average index was 6.0. However, we have found that the average reading in normals in the calf is approximately 3.5, and 6.0 in arteriosclerotics (Graph 1).

In the cases of thrombo-angiitis obliterans (Buerger's disease) the average oscillometric reading under normal conditions was about 2.0, which would indicate the gradient between the highest and the lowest possible readings. In contra-distinction to arteriosclerosis, these patients were never relieved by moderate exercise, massage or other activity, but rest and the judicious use of mild heat and vasodilatation were extremely valuable in all the vascular diseases.



Graph 1.

The interpretation of the oscillometric readings is interesting in that it does not actually measure the flow of blood in a part, but indicates the alteration in volume that occurs with each pulsation. There is also the pathological deposition of calcium in the vessel walls which limits the elasticity of the vessel, and permits it to function as a rigid tube which rises with each pulsation and transmits the impulse to the oscillometric cuff. Finally, pulsations are more easily transmitted to the inflated cuff because the musculature of the arteriosclerotic is ordinarily atrophic.

The skin temperature measurement, we believe, is far from an important procedure. Slight changes in the wet and dry bulb temperatures and relative humidity can produce wide variations in readings, which if interpreted in terms of circulatory function might be grossly inaccurate. The average skin temperature of the normal extremity is only a fraction of a degree less than that found in the arteriosclerotic, but considerably higher than in Buerger's disease. We feel that the most important influence on the surface temperature is the arterio-venous anastomoses which allow a shunting of blood directly from the arterioles into the superficial vessels.[3, 5, 4] In this way, blood may

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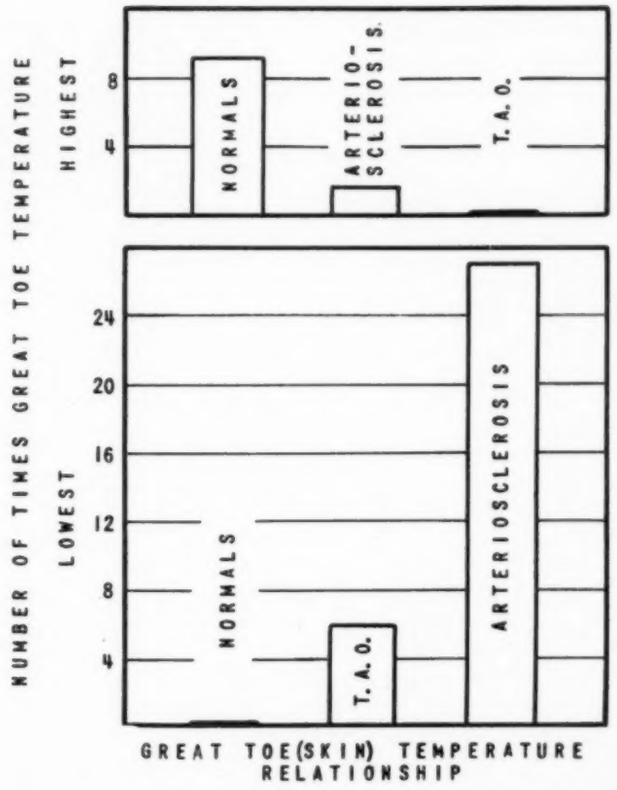


Graph 2.

flow into the cutaneous tissues before its temperature has been altered by passing through the capillary circulation. Since the arterioles are not primarily affected in arteriosclerosis, it is possible that the anastomosis may be responsible for the production of normal skin temperature despite the impairment of the gross circulation. This mechanism, in addition to environmental changes, renders the interpretation of the skin temperatures inaccurate; but any slight disturbance of the sympathetic system may be an additional factor which might alter the readings. At this point, one may conclude that normal temperatures of the skin do not exclude the possibility of arteriosclerotic vascular disease.

There is a progressive decrease in skin temperatures as one proceeds centrifugally, and it is interesting to note that the temperature of the great toe was highest of the entire leg in some patients, the lowest in about half, and the remaining between the highest and the lowest (Graph 2). The explanation of these differences may lie in the fact that the skin temperature can be altered by the arterio-venous anastomoses. We would repeat the statement that the temperature of the blood decreases centrifugally, but this does not mean that the skin temperature also decreases, since these anastomoses are found only in the distal portion of the extremity.[5] It is not a physiological impossibility for the skin to have a higher temperature peripherally than centrally. According to our own technic (after Stewart), we found that the blood flow in arteriosclerotics averaged about two-thirds of the normal, but lower in thrombo-angiitis obliterans cases (Graph 3). From a clinical standpoint, these findings compare favorably with the work capacity in practice, but one must remember

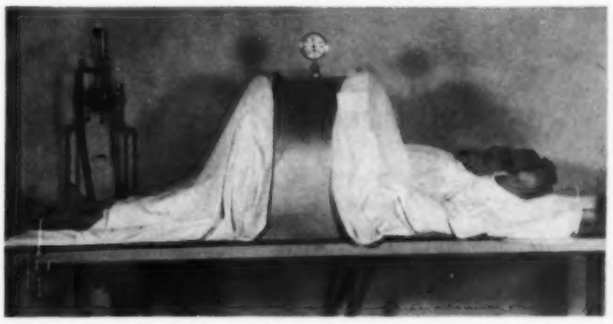
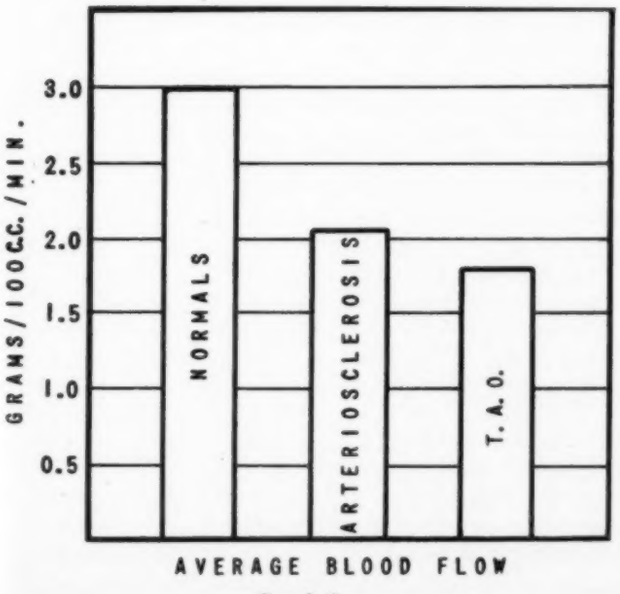


Fig. 2.

that there is a wide range of results and that slight errors in technic may entirely change them. Then, too, borderline readings are difficult to evaluate; and the metabolic requirements of different individuals may be partially responsible for this diversity.

Having established an efficient means for measuring the volume of blood flow by the calorimetric method, we have attempted to utilize it in practice. Using a modification of the principle employed by Gibbon and Landis[6] known as "reflex heat," we reverted to some of the earlier work produced by this department.[7] In a previously published report[8] it was shown that saturated heat was efficiently capable as a therapeutic measure, but in vascular diseases, any method of heating, if too great, could produce serious ulceration, massive necrosis or gangrene. A modification for treating backs (Fig. 2) and at the same time inducing temperature changes was employed to warm the blood in the trunk so that optimum dilatation of the vessels of the extremities might be obtained. While Wright[9] advocated an electric heating pad over the abdomen for 30-60 minutes once or twice daily, we have been able to treat this same area for a period of two to three hours, and the results of the



Graph 3.

calorimetric readings averaged approximately one-fourth above normal, depending upon the disease present. In our hands, the application of short-wave or infra-red directly to the part is contra-indicated, but if applied to the trunk, the effect does not last for any appreciable period. In the arteriosclerotic, the oscillometric readings are not materially changed, but the skin temperatures are definitely increased. In thrombo-angiitis obliterans, there is a perceptible change which is extremely gratifying. It is our feeling that the use of the capillary circulation, collaterals, and the arterio-venous anastomoses are definitely responsible for this improvement. We observed one group of patients which may be classified as vasospastic, with cold extremities, low temperature and oscillometric readings, apparently produced by an unstable sympathetic nervous system. With the removal of all extrinsic irritants, the improvement of this group was greatest of any we had observed.

Conclusions

WE have made a comparison of the most common methods of circulatory evaluation for peripheral vascular diseases.

2. The absence of the dorsalis pedis or anterior tibial pulsation is not indicative of vascular disease, and the presence of a pulsation does not rule out the existence of vascular pathology.

3. The oscillometric index of the leg is not markedly altered in arteriosclerosis, and normal skin temperatures do not exclude the possibility of vascular disease.

4. The arterio-venous anastomoses are offered as an explanation for the variations that normally occur in skin temperatures.

5. The calorimetric method of blood flow determination after Stewart, indicates that the volume in patients with vascular disease averages about two-thirds of that in normal subjects.

6. Means of inducing reflex heat by saturated air is offered as safe and flexible. Other methods have been tried, and are not as satisfactory in the hands of the author.

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Cow's Horn as a Cortico-medullary Bone Splint

—Review of the Literature and Report of Two Recent Cases—

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REHN and Wakabaiashy[1] in 1911, following reports in the literature that human hair had been successfully used as blood vessel suture material, advocated horn as a plastic material in the treatment of suitable types of fractures. They found that horn could be rendered sterile in thicknesses of one cm. by boiling in water for 20 minutes. Horn plugs five-tenths cm. thick and three to four cm. long were introduced into the medullary cavity of artificially produced fractures in animals. These animals were able to walk and run four weeks after the experiment. Autopsy at six weeks afterward showed solid union. Microscopic study showed periosteal proliferation, and extensive bony callus from both the periosteum and endosteum. The horn plug was firm and slightly swollen. Following his experiments on rabbits, Rehn employed cow's horn in nine patients with good results, in one of which a ring of horn was used. Rehn emphasized the availability of cow's horn, the ease of sterilizing, the strength of the material and its slight irritating effect as a foreign body.

V. Mish[2] in 1912, pointed out that transplanted autogenous bone plays a role of purely passive transitory prosthesis participating in the process of substituting the defect only by its salts and by the irritation which its presence produces. He emphasized the fact that transplanted bone, even when transplanted without periosteum, is subject to aseptic necrosis and is substituted by newly developed bony tissue derived from the periosteum of the transplant, the periosteum into which the transplant has been introduced and, to a lesser extent, the bone marrow of the latter. Since there remained no important difference between the processes of repair where respectively autogenous and heterogenous transplants are used, he welcomed the trial of cow's horn in plastic bone surgery in the form of plates or plugs, preferably perforated to reduce the mass of the introduced foreign body. Mish had not known of Rehn's previous work when he published his paper.

Edson B. Fowler,[3] in 1934, revived an interest in the use of cow's horn concerning which rather little had been heard for many years. He brought out the fact that horn is a keratin substance and that it contains large quantities of cystin, shown by Hammett and Reimann to stimulate growth by

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increased mitosis. He quoted Brunsting and Simonsen as having stimulated granulation tissue in old chronic ulcers with cystin. Dr. Fowler reported nine clinical cases of his own together with 21 others, which he had collected from the literature, chiefly from the Lexer and Boliarsky clinic. Fowler's work seemed to indicate that cow's horn had the ability to stimulate bone repair through the influence of its cystin, in addition to its usefulness as a reliable fixation agent.

Seigling and Fahey, University of Chicago,[4] in 1936, conducted an extensive study of the conflicting views with reference to the reaction of tissues in cow's horn and the ultimate fate of the material after retention in the body for internal fixation. They pointed out that Fabricius, in 1647, and Icart, in 1775, had employed metal in soft parts and bone; that Lambotte, in 1911, had reported a series of cases in which 46% of metal plates had to be removed for various causes; that Dahl-Iversen in 1927 had reported osteitis in 28% of 174 uncomplicated cases where Lane plates had been used; that many surgeons, discouraged with foreign substances they had employed in bone work, were turning to autogenous bone for internal fixation; and that laboratory workers were continually searching for material which might have the advantage of the autogenous graft without the necessity of removing bone from the same or another operative field. Henderson had stated that beef-bone screws are well tolerated by bone and are completely absorbed from within six months to a year and that beef-bone pegs, during absorption, are replaced by new living bone. Dahl-Iversen, in 1929, was of the opinion that horn was absorbable and thought that because of this fact the common complications following the use of non-absorbable material would no longer occur. Later his experimental work failed to confirm this opinion. He placed horn plates in slots made in the cortex across the site of a fracture and observed that the horn was not absorbed but became softer from body temperature and fluids. At autopsy, in clean cases, the horn plates were covered with connective tissue and were situated in newly formed periosteal bone. In Seigling and Fahey's dog cases, tibias were fractured transversely and a section of cow's horn was passed into the medullary cavity across the fracture line. The extremity was immobilized in plaster eight weeks. Fistula developed in three cases at nine, 10 and 13 weeks after primary healing of wounds. The remaining animals were sacrificed at six and 31 weeks after operation. In one experiment both tibias were fractured, horn was used in one and the other allowed to heal as a control. Both legs were immobilized in plaster. Their conclusions were that, where horn was used as a corticomedullary graft, microscopic study of cases as late as seven and one-half months after operation revealed little, if any, absorption or stimulation of osteogenesis; that cow's horn is relatively non-absorbable and the tissues react to it as they would to other non-absorbable material; and that cow's horn appears not to stimulate osteogenesis.

W. B. Carrell, Professor of Orthopedic Surgery, University of Texas,[5] in 1936, made elaborate experiments showing the remarkable tensile strength of cow's horn as compared with other materials in common use. He showed that the cystin content of specimens of horn, removed after remaining in bone tissue, showed a shrinkage of 25%. He reported more than 50 cases in which nails, rods, plates or slabs of cow's horn were used in the clavicle, humerus, radius, ulna and around the processes near joints. His conclusions were that horn has high tensile strength but also flexibility for easy application; that specimens should be sterilized by an hour of preliminary boiling and again for 30 minutes before operation; that absorption probably requires eight or 10 months and that it is tolerated by the tissues as a harmless foreign body; that the release of cystin is so slow that it is of doubtful value in stimulating bone repair; and that if union takes place it cannot be attributed to the cystin action.

Report of Two Cases

FOR undetermined reasons, possibly the mere neglect of a valuable internal fixation agent that is being forgotten, little use of cow's horn seems to have been recently made. We have been unsuccessful in finding any reports in the Surgeon-General's Library or elsewhere subsequent to 1936. Therefore, while two additional cases of fractures of both bones of the forearm may contribute comparatively little information, we wish to report these from the Evanston Hospital.

One of these was complicated by a rather severe dermatitis due to the patient's sensitiveness to adhesive plaster and also by the fact that in the same forearm, the fractures of the radius and ulna near their mid-points was complicated by a Colles fracture of the same wrist.

The other of our cases was complicated by the ulna being compounded in the original injury resulting in a subsequent osteomyelitis. This case also had the disadvantage of not being seen until several months after treatment elsewhere. It was also complicated by an ischemic paralysis from a tight plaster cast applied at the time of injury. It also includes the unique feature of the experimental introduction of a corticomedullary cow's horn splint into the infected ulna although for safety a similar splint introduced into the clean radius was the factor relied upon for fixation of both bones. We know of no other instance where cow's horn has been used as a corticomedullary splint in supporting bone.

Patient, Mr. R. L., age 27

THIS patient was admitted to Evanston Hospital November 8, 1938, for an overriding malposition of a comminuted fracture of both bones of the left forearm. There was also a Colles fracture of the left radius which showed satisfactory reduction. Since it had seemed unwise to pass a wire through the Colles fracture line of this radius for extension against a similar wire in the olecranon, adhesive plaster traction had previously been ap-

plied which, at the end of 48 hours, had produced sufficient dermatitis to require removal. This was followed by a tedious three weeks of skin preparation before admission was safe for open reduction. On November 9, 1938, through an ulnar incision, the mal-union of that bone was exposed, the callus chiseled away and the ends freshened and freely mobilized. The ulnar wound was then left open during an identical procedure on the radius of the same extremity through a separate radial incision.

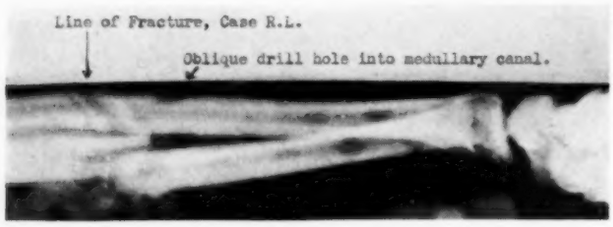

Fig. 1.

The mobilization of both bones made manual end-to-end reduction easily possible. A bone drill was entered into the cortex of the lower fragment of the radial shaft one inch below its upper extremity and, directed upward at 45°, was carried into the medullary cavity. This drill hole was then reamed out to a diameter of ¼ inch. Then a piece of cow's horn one-fourth by four inches was driven through this drill hole into the marrow cavity of the lower fragment and continued on into the marrow cavity of the lower end of the upper fragment until snug anchorage and alignment was secured. The excess of the proximal end of the corticomedullary splint was cut nearly flush with the cortical surface leaving only enough projecting to grasp in the event of the necessity of subsequent removal. Owing to the comminution, at the time of injury, of the proximal end of the distal fragment of the radial shaft, a longitudinal fracture, previously unseen, was spread by the introduced cow's horn. One strand of kangaroo tendon was placed about this portion of the radius to support the cow's horn splint and crushed comminuted bone fragments were planted about the fracture site. The radial wound was now closed and the ulnar wound, which had been left open, revealed the ulnar fragments were already maintained in excellent position from the support of the radial corticomedullary splint. This wound was then closed and a right angle perforated posterior metal splint was applied from the finger tips to the axilla with the forearm in supination, and a supporting volar splint of yucca board was placed on the forearm.

Both radial and ulnar wounds were entirely healed with no redness or tenderness on November 30, 1938. On December 5 there was a slight return of the former adhesive plaster dermatitis and on December 16 the skin of the forearm around and between the scars showed many minute, yellow blisters with itching. On December 23 both bones were bowing at site of fracture and were realigned by manual pressure but the dermatitis had disappeared. On December 30 physiotherapy was begun. On January 6 fluctuation was palpated beneath radial wound, which was suspected as being due to an aseptic irritation from the radial corticomedullary splint. On January 9, 1939, drainage of considerable syrupy white fluid without odor, which showed no bacteria present, was observed after incision of the fluctuating area for the removal of the cow's horn which was found loosened. On January 19 the radial swelling was much less, the drainage was almost gone and the ulnar union was more firm. January 23 the patient fell downstairs striking on his left or operated forearm, after which the radial wound became fluctuant and reddened. February 3 a new right-angle gutter splint was applied for better alignment of both unions, which were still soft. On February 13 the splint was permanently removed. This patient has been able to play golf since the spring of 1939.

In this patient the ulnar wound, where no splint had been introduced, has always remained healed. The primary healing of the radial wound was interrupted by the extrusion of its corticomedullary splint from aseptic necrosis two months after operation. The subsequent union of both bones was only temporarily disturbed by a fall down stairs striking on the operated forearm two and one-half months after operation.

Patient, Mr. E. D., age 36

ON APRIL 26, 1934, this patient, a farmer, reported that his right forearm had been crushed beneath a pile of wood on January 8, 1934, and that the proximal fragment of the ulna was found protruding through the skin leaving a wound from which a cup full of pus was drained at the time the original cast was removed three weeks later. He said that pieces of bone had come from this wound from time to time. He stated that the original plaster cast had been put on the arm by another surgeon without x-rays being taken and that after many days of pain he threatened to remove it himself. When the doctor removed it finally, after the cast had been on three weeks, the patient was unable to lift his wrist or move his forearm. During the next 11 weeks he was in an

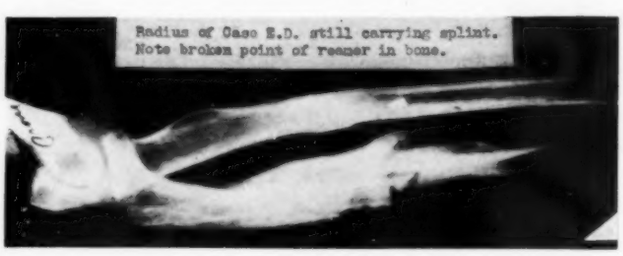

Fig. 2.

ambulatory splint with traction during which time the forearm was continuously swollen. On July 16, 1934, he was admitted to the Evanston Hospital after about three months of physiotherapy to better prepare him for surgery. He gave a history of a broken wrist in 1916 and a broken jaw in 1926 from both of which he had made a good functional recovery. He appeared to be in fair general health except for a continuous low temperature and some loss of weight. On July 17, 1934, an open

reduction was performed on this right forearm which showed a suppurating sinus over the provisional mal-union of the ulna. Exposure revealed an over-riding of each bone of about one inch. The radial mal-union was very firm. The ulnar union was fibrous and showed an osteomyelitis. The radius was exposed and the fragments chiseled apart. The ends of the fragments were cut off and freshened and the medullary canals were reamed out in preparation for a corticomedullary splint. The proximal portion of the distal fragment, about one inch from its freshened end, was drilled into the medullary canal at an angle of 45°. The wound was then covered with gauze and the arm turned to the ulnar or septic side. The discharging sinus there was dissected out, the fibrous mal-union cut away, the ends trimmed and the closed canals reamed out. The proximal end of the lower fragment was drilled at 45° as was done with the radius. A cow's horn corticomedullary splint was driven through the drill hole and on into the medullary cavity of the opposite fragment. This previously infected ulnar wound was loosely proximated for drainage with silk-worm gut, and an isolation dressing applied. The arm was now turned back again to the clean, previously operated, radial side with a fresh surgical layout. A cow's horn corticomedullary splint was inserted here in the same manner. The wound was closed anatomically with a subcutaneous drainage of silk worm gut strands.

The laboratory reported a gram-positive coccus but no fungi in the ulnar wound. The progress of this patient during the next five months was satisfactory in a general way but there was periodic drainage from the ulnar wound. The radial wound had healed by first intention and has remained so. The general function of the hand and forearm had improved.

The patient was readmitted to the Evanston Hospital, December 5, 1934, for the removal of three ulnar sequestra, the largest being 3½ cm. by 1½ cm. On February 11, 1935, the patient reported having fallen on the injured forearm a few days before. Since that time the lower angle of the ulnar wound had become tender and the patient was conscious of a movable bone-like body beneath the skin at this point which appeared as a dark area in the midst of some granulation tissue. This area was opened in my office and what might have been a sequestrum was found to be the proximal end of the cow's horn splint which was easily removed. On August 15, 1935, the patient reported that two or three spicules of bone had been extruded from the ulnar wound. Since that time the patient has been able to pitch hay and resume his other farm work and makes good use of his right forearm and arm.

This patient's radial wound has always remained healed and the radial corticomedullary splint is still being worn without irritation. The ulnar, or infected, wound has remained healed since the last small sequestra were extruded six months after the removal of the ulnar corticomedullary splint in 1935. This patient survived a fall

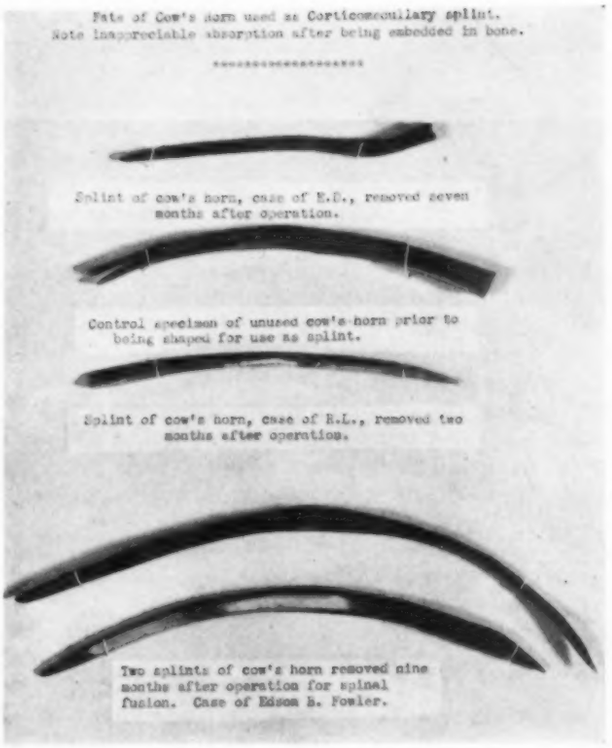
Fate of Cow's horn used as Corticomedullary splint.
Note inappreciable absorption after being embedded in bone.
Splint of cow's horn, case of E.D., removed seven months after operation.
Control specimen of unused cow's horn prior to being shaped for use as splint.
Splint of cow's horn, case of E.L., removed two months after operation.
Two splints of cow's horn removed nine months after operation for spinal fusion. Case of Edson B. Fowler.

Fig. 3.

on the injured forearm six months after the open reduction. Probably as a result of this fall, and possibly eventually anyway from irritation of the splint, the latter was removed a few days later. Thus was shattered the somewhat distant hope that in this particular case a corticomedullary splint of cow's horn, intentionally introduced into suppurating bone, might be accepted and remain there undisturbed.

Technique

THE technique we have employed is probably similar, if not identical with that of other operators who have used cow's horn. After adequate mobilization a one-fourth inch drill penetrates the cortex of one of the fragments about one inch back from the line of fracture and at right angles to the long axis of the bone. The drill is carried in

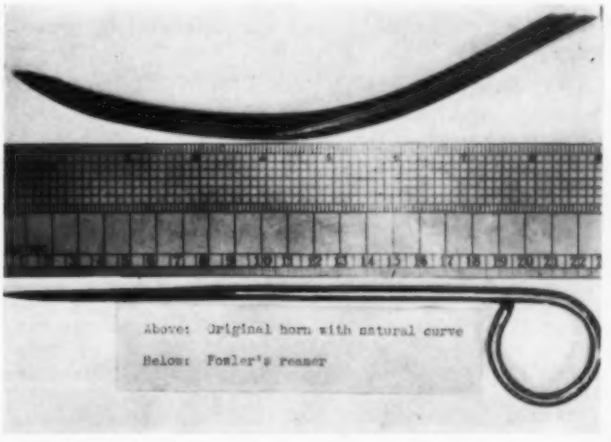

Fig. 4.

about one-fourth of an inch and then is tilted in the long axis of the bone at 45°. At this angle the drill is then carried well into the medullary cavity and withdrawn. Fowler's reamer, here illustrated, is then utilized to enlarge the passage made by the drill for the introduction of the proposed cow's horn splint. A piece of cow's horn approximately four inches long with its natural concavity upward is then driven through the reamed-out drill hole into the medullary cavity of the first fragment and on into the medullary cavity of the second. It should fit tightly and automatically bring the fragments into firm alignment. Any excess remaining of the proximal end of the splint is then cut off leaving only enough protruding for the application of an extractor when and if the splint must later be removed.

Conclusions

COW'S horn is obtainable in rural communities and can be secured from the stockyards of our cities.

It can be cut, sawed, shaped or turned into plates, screws, nails or rods and rendered sterile for use.

It possesses amazing tensile strength for prolonged internal bone splinting.

Cow's horn has a spring and a pliability that permits either a straight plate or rod of it to be applied to bone surfaces; or a rod with the natural horn curve to be introduced through a single drill hole into a medullary canal or driven into a drill hole leading at a slight angle into the medullary canals of both fragments.

A curved piece of cow's horn thus driven through an oblique drill hole and into the medullary canal of one fragment can be made to emerge and continue across its fracture line into the medullary canal of the second fragment for fixation and alignment.

The resiliency of such a curved piece of horn automatically maintains the fragments in surprisingly satisfactory alignment.

Splints of horn left in bone many months seem to remain only very slightly changed by prolonged contact with bone, blood, pus or body fluids and probably exert the same local irritation characteristic of other foreign materials in common use. Our horn splints in these two reported cases and here illustrated would seem to support this assertion.

It is unfortunate that cow's horn is not opaque to x-rays and only the bone contacts can be studied roentgenographically.

The Lane technique, as far as possible, should be employed in the procedure of cow's horn introduction.

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Thrombophlebitis of the Veins of the Lower Extremities

—Following Effort and Strain—

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VENOUS thrombosis associated with indirect trauma or effort has already been accepted as a clinical entity in connection with the upper extremities, the syndrome being known as thrombosis of the axillary vein. It is the purpose of this paper to describe the same form of venous thrombosis as it develops in the lower extremities with a view to extending the scope of the entity to include thrombosis of the veins of the *lower* as well as of the upper extremities.

It may be well to review briefly the accepted factors or conditions which are known to favor thrombosis in veins. These are:

1. Changes in the blood constituents induced by toxic or infectious states which render the blood more liable to intravascular clotting.

2. Changes in the rate of flow, that is, a general circulatory slowing which may be associated with cardiac disease or prolonged bedrest, or a local slowing which follows pressure on a vein by a mass, tumor or surrounding structures, such as the pressure of Poupart's ligament on the femoral vein when the patient is in a prone position or the compression of the left common iliac vein by the right common iliac artery.

3. Changes in the vessel wall either in the endothelium or the adventitia.

4. Changes in the relation of the vein to surrounding structures due to change in position of the extremity; namely, the axillary vein assumes a different relation to the costocorocoid ligament and the subclavius and subscapularis muscles when the arm is abducted.[1,2]

5. Changes both local and general which may occur following trauma through a substance released in the blood and termed by Vance the "X" factor.[3]

Intravascular thrombosis may follow direct trauma in both veins and arteries although its occurrence in the former is more common than in the latter. This may be explained by the fact that the walls of the veins are thinner, less elastic and under lower pressure.[4]

Indirect trauma in the form of a strain or a sprain or a twist involving the upper extremity produces the clinical entity called primary throm-

bosis of the axillary vein or thrombophlebitis par effort. The degrees of indirect trauma varied in the reports, ranging from barely noticeable and slight to severe. DeTakats reported thrombosis in the axillary vein following the grinding of a spark plug.[5] It is known to have followed diverse activities, such as checking and restraining a horse,[6] swinging a golf club,[7] pitching a ball,[8] exercising in a gymnasium,[7] lifting an ordinary pressing iron,[8] picking up a cake of ice,[8] and taking a storage battery out of a car.[8] The basis for its occurrence has been explained by several investigators. Von Schroetter believed that the sudden stretching and compression of the axillary vein produced a localized phlebitis which resulted in a thrombosis. Another explanation was advanced by Lowenstein[1] who dissected 37 cadavers and found that with the arm abducted, the costocorocoid ligament and subclavius muscle indented the axillary vein. With the vein distended, the pressure of the costocorocoid ligament or subclavius muscle upon it was sufficient to produce a thrombosis. The findings were confirmed by Gould and Patey[9] who, in addition, demonstrated the presence of a valve at the level of the subclavius muscle. Pressure of the muscle stretched the venous wall in its long axis so that this valve ruptured causing the thrombosis. Veal and McFetridge,[2] on the basis of roentgenographic and autopsy studies, contend, on the other hand, that the constriction of the veins did not occur at the points described by the previous authors but in the region of the head of the humerus and against the subscapularis muscle.[2]

The relation of effort to venous thrombosis in the lower extremities has been rarely described at any length nor has any explanation been advanced for its formation. Searching the literature one finds brief mention by DeTakats[5] of a sprain of the knee or ankle which resulted in thrombosis in normal non-varicosed superficial veins. He also states that such cases have been reported by Imbert, Cottalorda, and Lionelli. Martland[10] cites a case of death from pulmonary embolus following a sprained ankle. On autopsy the deep veins of the calf were thrombosed with red clots, and fragmented emboli packed both branches of the pulmonary artery. Homans,[11] too, reports thrombosis in the deep veins of the leg following a strain and a twist. But in no instance is the mechanism of the thrombosis explained.

Venous thrombosis in the lower extremities without direct trauma to the same has been reported by Vance.[3] In the course of his duties as Medical Examiner of the City of New York he performed autopsies in 90 cases of thrombosis of the veins of the lower extremity which had been followed by pulmonary embolism and death. Sixty of these cases developed subsequent to definite trauma. The trauma varied from serious to slight and were definite enough to persist until the patient died but not severe enough to cause death before the embolism had time to develop. In 50 of these 60 cases the injuries were: fracture of the femur, 14; fracture of the tibia and fibula, 11; fracture of the tibia, two; fracture of the fibula, seven; fracture of the pelvis, five; and miscellaneous injuries of the lower extremities, 11. The thrombosis in the vein developed on the same side of the body as was injured. In the remaining 10 cases of the 60 the site of the thrombosis bore no apparent relationship to the site of the injury. To be specific, they were: fractures of the skull, two; fracture of the skull and ribs, one; fracture of the lumbar spine, one; chest injury, two; fracture of the ribs, one; injury to the head, one; fracture of the right humerus, one; incised wound of the chest and abdomen, one. The left femoral vein was thrombosed in three cases, the right femoral vein in four cases, the inferior vena cava in one case, and in two cases a thrombus could not be located in any of the veins. The other 30 of the 90 cases were not associated with any definite traumatic lesion. They followed operations and pregnancies and were associated with varicose veins and other conditions.

Microscopic examination of segments of thrombosed veins from both the traumatic and non-traumatic series revealed no essential difference in the pathological lesions of the vessel walls and adjacent tissues. In both instances the thrombosis was confined to the veins of one extremity.

To account for venous thrombosis in the lower extremities following remote accidents such as a fracture of the skull or of the ribs we must agree with Vance that trauma releases a substance into the blood termed an "X" factor which possesses thrombophlebitic properties. When this substance strikes a diseased vein or one of lowered resistance a thrombophlebitis may occur.

Since there are as yet no definite opinions explaining thrombophlebitis in the veins of the lower extremity after indirect trauma, we must assume that a sprain or a strain stretches muscles, tendons or ligaments and at the same time stretches the vein. This stretching of the vein results in a localized phlebitis or rupture of a valve, which suffices to initiate thrombus formation.

I PRESENT the following case reports of thrombosis of the veins of the lower extremities associated with effort in which no direct trauma played a part.

CASE 1: L. K., age 26, a truckman, on October 8, 1940, lifted a 200-pound carton. He experienced a sudden sharp pain in the left lower back, hip and groin. On the following day his left leg was heavy and slightly swollen. Nevertheless he continued with his occupation. The leg and thigh gradually and progressively increased in size so that by the thirteenth day he was unable to bear weight and was forced to bed. At that time a group of veins appeared over the external aspect of the thigh and hip and over the pubic region and lower abdomen.

Examination on December 6, 1940, approximately two months after the injury, revealed a well nourished male in whom the physical and laboratory findings had no relation to the local complaint.

The entire left lower extremity was edematous and cyanotic. Tenderness and induration were observed over the saphenous and femoral veins. Many varicosities were present over the external aspect of the left hip, pubic region and lower abdomen. There was no interference with the arterial circulation.

The diagnosis in this case was that of an ileofemoral thrombophlebitis following a back sprain.

The patient was put to bed with the foot of the bed elevated nine inches until the edema subsided. This required about six weeks. Subsequently an Ace bandage was applied and the patient became ambulatory. When last examined the left lower extremity was still slightly larger than the right and the veins previously described were still prominent.

Comment: The sprain of the back was the immediate cause of the thrombosis involving the ileofemoral venous plexus. At the time the muscles of the lower back were sprained, the veins were stretched. This distension in itself could have produced a localized phlebitis in the vein as a starting point for the thrombosis. Or, one of the venous valves in the region might have ruptured and provided a seat for the onset of the thrombophlebitic process.

CASE 2: I. S., age 28, a paper cutter, on November 2, 1939, stepped on a roll of paper which slipped. He twisted his left knee. There was no direct injury to the extremity. He continued working until two days later when he felt pain in the left knee. On the third day he became bedridden when his temperature rose to 102.4°. The pain in the knee became more intense, radiating down the leg and up the thigh. A tender hard mass developed on the internal aspect of the aforementioned regions.

Physical examination failed to reveal any significant general findings. Both lower extremities were exposed and the left calf was seen to be definitely larger than the right. At the level of five inches below the patella the right calf measured 12½ inches and the left calf 13⅜ inches, a difference of seven-eighths of an inch. Edema and cyanosis were absent. Plantar ischemia and dependent rubor were not demonstrable. The right and left femoral, popliteal, anterior, posterior tibial and dorsalis pedis arteries were all of equal volume.

The diagnosis was a traumatic phlebitis in a non-varicosed superficial vein associated with a sprain of the knee.

With elevation of the foot of the bed six inches and application of wet dressings the symptoms subsided and the phlebitis disappeared so that on December 4, 1939, approximately one month after the injury, this patient returned to work.

Recent examination failed to reveal residual signs of phlebitis.

Comment: This is a case of phlebitis following a sprain of the knee in an individual who was previously well with no antecedent history and no evidence of superficial varicosities.

CASE 3: R.S., 47 years of age, white, a painter, on September 10, 1937, stood on a plank supported by two wooden horses to paint a wall. He descended to move the plank but it tilted towards the wall and threw him off balance. He twisted his back and felt a sudden pain in the lower left lumbar region. Within a half hour he was seized with a chill which lasted several minutes. He completed the day's work and continued working for the next 12 days. The pains increased in severity so that at the end of the twelfth day he could not walk because his legs were heavy. On September 25, 15 days after the injury, his left lower extremity also became swollen from the toes up to the groin. He was hospitalized on September 30, 1937, and during the second week's stay in the hospital his right lower extremity also became swollen. He remained in bed about six weeks. Upon discharge from the hospital the edema had considerably diminished but there was still a moderate amount of swelling in both lower extremities. To overcome this he wore elastic bandages. In March, 1938, approximately six months after the accident, he returned to work.

General physical examination revealed a well nourished and well developed male. There were no abnormal physical findings. Locally, both legs were enlarged with the right more so than the left. Numerous varicosities were present over the lower abdomen, both groins, pubic regions, legs and thighs. The veins over the right scrotal region were dilated and distended. There was no evidence of arterial insufficiency.

The diagnosis in this case was an ileofemoral thrombophlebitis of the left lower extremity following a twist of the lower back, which subsequently involved the right lower extremity.

Comment: The sudden twisting of the back followed by a chill was the initiating factor in the thrombophlebitis of the left lower extremity. To explain the involvement of the opposite extremity which was the uninjured side, we must consider one of the following two possibilities. First, that the thrombus may have extended from the left external iliac to involve the common iliac and have continued on to the inferior vena cava. From there the thrombus may have extended distally to involve the right common iliac and its branches resulting in the swelling of the right lower extremity. Secondly, that the prolonged rest in bed in an individual who had a thrombophlebitic diathesis could very well have been the cause for a similar process developing in the opposite extremity.

CASE 4: E.T., male, age 50, a porter, on December 8, 1939, slipped and twisted his left leg. He felt a soreness in the left calf region. Towards the afternoon he developed a lameness in his foot and leg and walking became painful.

Examination revealed a well nourished male in whom no other evidence of pathology could be found. The left leg and ankle were not swollen. There was no ecchymosis nor were there evidences of color or temperature changes associated with arterial disease. Superficial varicosities were not seen. Slight tenderness was elicited on deep pressure over the calf muscles. Extreme dorsiflexion of the foot on the leg produced complaints of pain high up in the calf. Patient was put to bed, the leg elevated and wet dressings applied. At the end of seven days, tenderness on dorsiflexion had disappeared. He was permitted to exercise his legs in bed for the next four days and after that time was allowed to walk with an elastic bandage. The activity periods were gradually increased so that at the end of three weeks he walked continually and on February 2, 1940, approximately two months after the injury, he was able to carry on his duties free from all symptoms and without bandage supports.

The diagnosis in this case was thrombophlebitis of the peripheral plexus of veins in the flat muscles of the calf region following a sprain.

Comment: This syndrome is not readily recognized. Its cause is usually trivial. It may follow an injury below the knee, such as a strain of the ankle, or may be associated with a fracture of a bone of the foot. Part of the posterior or anterior tibial or the peroneal plexuses of veins may be involved. The complaint of pain, referable to the upper calf on extreme dorsiflexion of the foot, has been described by Homans[11] and is considered pathognomonic of this syndrome. The progress in this condition is usually judged by the response of the patient to this sign. As the thrombophlebitis subsides the pain elicited by this test decreases and ultimately disappears. Occasionally, in some instances, the pain will reappear after activity and the thrombus may extend upward into the femoral vein. If, at this stage, the vein is not ligated, further extension into the pulmonary system may follow causing pulmonary embolism and sudden death.

CASE 5: S. R., female, age 26, while walking, on February 19, 1940, slipped and twisted her right ankle. There was no direct trauma to the ankle. Wet dressings and rest were advised. Three days later redness on the internal aspect of the leg along the entire course of the saphenous vein was observed.

Examination on February 25, 1940, revealed a slight swelling of the ankle and an area of phlebitis along the course of the saphenous vein from the ankle up to the groin. Temperature was 102°, pulse 100. There were no evidences of abrasions or lacerations. With elevation of the extremity and wet dressings the phlebitis subsided so that on March 7, 1940, 18 days after the injury, with the aid of an elastic bandage, patient was able to bear weight. The bandage was worn for about five weeks, at which time there were no residual evidences of phlebitis or edema of the ankle.

The diagnosis in this case was traumatic thrombophlebitis in a superficial non-varicosed vein following indirect trauma in the form of a sprain of the ankle.

Summary

CASES of venous thrombosis of the lower extremities associated with indirect trauma or effort have been described.

2. A brief review of the mechanism of venous thrombosis as it occurs in the upper extremities has been submitted in explanation of the mechanism in the lower extremities.

3. Thrombophlebitis of the veins of the lower extremity can occur following trauma to other parts of the body. The occurrence in such cases has been explained on the basis that trauma releases a by-product in the blood termed an "X" factor which changes the state of the blood so that thrombosis of the veins develops in the least resistant portion of the body.

4. In view of the findings presented, thrombophlebitis of the veins of the lower extremities associated with indirect trauma or effort, appears to be a definite clinical entity.

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Historical Milestones

—In Occupational Medicine and Surgery—
—Isbrand de Diemerbroeck—
and
—Guilielmus Salmon—

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HAVING in a previous paper presented a discussion of the first printed book dealing exclusively with occupational diseases (INDUSTRIAL MEDICINE, May 1941, Volume 10, Number 5) before turning back to the references to occupational diseases in the manuscripts of the ancients, and before considering the later periods, with printing enabling physicians to present more adequately their clinical observations, let us turn to that period between the time when the first book was printed and the later period introduced by Ramazzini, to consider the writings of Isbrand de Diemerbroeck, as translated from the Latin by Guilielmus Salmon into English.

Published in 1696, in London, this thick small folio deals only briefly with occupational disease pathology, but this brief description illustrates clearly the transition from anatomical repetition of the writers of many centuries to the writings of accurate clinical observation. The Diemerbroeck observations heralded an appearance in English texts of occupational diseases. There is a definite change from the theoretical reasoning encountered in the writings of Aristotle and the writings of Galen.

Medical literature from this time on was to be characterized by correct clinical observation and rational interpretation of the relationship between the occupation and the clinical findings.

This edition of Isbrand de Diemerbroeck, herewith illustrated, is a small folio, cover of panelled calf, 897 pages, published in London in 1694. The title page further informs us that the translation from the Latin is by Guilielmus Salmon, Professor of Physick, and that the edition was printed for W. Whitwood at the Angel and Bible in Little-Britain, at which place all of Dr. Salmon's works are sold.

Doctor Salmon's preface, in addition to observations consisting of sound advice for present-day authors, provides us with an insight into the character of Diemerbroeck, and thus permits us to evaluate the soundness of his observations. Furthermore, our present-day knowledge corroborates the opinion formed by reading the direct quotations from the first edition of Diemerbroeck's writings.

Preface

SALMON introduces his subject as follows:
"How beneficial the exact knowledge of the Fabrick of humane Bodies is, and how difficult the same skill is to attain, the continual improvement in Anatomy one Age after another, notwithstanding the utmost diligence of the last, do sufficiently evince."

He goes on to describe the difficulties of obtaining anatomical knowledge and mentions the philosophers and physicians of all ages, calling attention to the work of Democritus and Hippocrates, the two parents of solid philosophy and physic. He further mentions:

"Many more great Men among the Ansients, such as Aristotle, Diocles, Erasistratus, Praxagoras, Herophilus, Asclepiades, Euripho and others cultivated this Province; but none in former Ages excelled Galen.

He then calls attention to others who were interested in changes in the human body, referring to "even Kings and Emperors were both Specta-

tors of, and Actors in it. Alexander the greatest of Emperors, employed both himself and his Master Aristotle sometimes in Dissections, notwithstanding his Conquests and great Affairs.

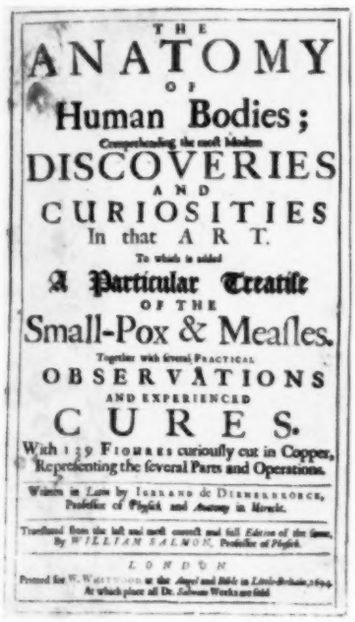
"Certain also it is, that Boethus and Paulus Sergius the Roman Consuls, and other great personages, both Learned and War-like, honored Galen with their presence at his Anatomical Administrations.

"What an exquisite piece of folly would it appear to be, if a man skilled in Minerals and Plants, and in most other subjects of Natural enquiry, yet should not know the Animal Oeconomy at all?

principally, what I have here to say, shall be employed. He says, he had for several Years been conversant in Anatomical Studies; that in teaching others, he had learned many things himself that were new, and till his Time altogether unknown; upon which he resolved to write a Book of particular Observations, and make them publick, as he saw several others had done before him.

"He further, in his First Edition, engaged, that whatever hereafter he should find lying hid in obscurity, he would bring to light, and when he died, that he would bequeath all to Posterity. For as long as the Desire of advancing Anatomical

Isbrand de Diemerbroeck


THE
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Comprehending the most Modern
DISCOVERIES
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CURIOSITIES
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A Particular Treatise
OF THE
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CURES.
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Written in Latin by ISBRAND de DIEMERBROECK, Professor of Physick and Anatomy in Utrecht.
Translated from the last and most correct and full Edition of the same, By WILLIAM SALMON, Professor of Physick.
LONDON
Printed for W. Whitwood at the Angel and Bible in Little-Britain, 1694.
At which place all Dr. Salmon Works are sold.

"The Anatomy of Human Bodies"

Guilielmus Salmon

"Though by what has already been said, you see the Credit and Reputation Anatomy has in former Ages been, yet the Study of it never flourished more than in this last Age, wherein so many are so strenuously industrious, that one would think in our Age it might be brought to perfection. Who can ever forget the Learned *Asellius*, for finding out the Lacteal Veins? No less than immortal Glory can be due to the Renown'd *Harvey*, our Countryman, for finding out the Circulation of the Blood. He that cannot acknowledge the Excellence of our *Willis* for his Anatomy of the Brain, must never pretend to the subject Discourse. The curious Researches of our *Wharton* on the Glands surpass what has been said in former Times. The Scholastic and Learned *Glisson* has performed his Share in trasing the Meanders of the Liver-Vessels. The acute *Lower* has shown in sensible Terms, how the prime Mover of the Humane Machine exerts its Power. The renowned *Bartholinus in Denmark*, the *Swammerdam's, Bilsius's, de Graaf's*, and other in the Low-Countries; but especially the Learned and Laborious *Diemerbroeck*, in *Utrecht*, have raised to themselves immortal Monuments of their Learning and Industry about this Subject. And upon *Diemerbroecks* Labours Knowledge should continue in the World; he knew innumerable other things would be produced, which we cannot now so much as dream of, such he recommends to Posterity, and that out of Love to the common Welfare, Men would not hereafter scruple to undertake this Province."

Salmon goes on to point out that Diemerbroeck endeavored to include all the new things which either he could find out or were hitherto found out by the best of Anatomists.

Guilielmus Salmon thus having given the reasons for Diemerbroeck's writing, and calling attention to his accuracy and integrity, then proceeds with the translation.

Translation

THE first part of this book consists of "The Explanation of the Sixteen Plates." With the completion of this explanation the various parts of the body are given consideration, and in Chapter 13, on page 351, the chapter titled "Of the Middle Belly or Breast," under Paragraph 4, which is designated in the margin "Preternatural things in the Lungs," Diemerbroeck describes pathological changes in the lung which are the result of occupation.

PRETERNATURAL THINGS IN THE LUNGS

"IV. *Now that the Substance of the Lungs is Bladdery, Reason, besides common Sight, instructs us; for many times round, thick and stinking Spittle, impostumous Matter, little Bladders, Worms, little Stones, and other preternatural things are generated in the Lungs*:

"Of which Accidents Bauschius has collected several Examples; and we, in our Practice have seen many strange Things spit out of the Lungs; and found other things as strange in Persons dissected, which certainly were not bred in the Blood-bearing Vessels, nor in the fistulous part of the Pipe, which would have caus'd a Suffocation, violent Asthma, and perpetual Cough, but of necessity had been bred in the Vessels, and might, yea must have been contain'd there a long time.

OBSERVATION

"V. In the year 1649 I dissected a Stone-Cutters Boy that dy'd of an Asthma, in whose Lungs I found a great quantity of Stone-dust suck'd in with the Air, and stuffing almost all the Vessels, insomuch that I seem'd to cut through a heap of Sand; so that the Vesicles being fill'd with Dust, could not admit the Air, which was the occasion of the poor Fellow's Death.

"The next Year, two like Cases happen'd of Stone-Cutters that dy'd after the same manner, and were by me dissected in our Hospital. At the same time, the Master Stone Cutter reported to us, that while the Stones are cut, there flies into the Air such a subtile Powder from the Stones, as was able to penetrate the Pores of an Oxe's Bladder, that hung up blown and dry'd in his Shop, so that about the end of the Year, he found a handful of Dust at the bottom of the Bladder; which Powder was that which kill'd so many Stone-Cutters, that were not very careful how they preserv'd themselves from that Dust. So that if such a Quantity of Dust penetrates by drawing in the Breath into the Vesicles of the Lungs, there is no question but Air runs through all those Vesicles. We saw a Third that dy'd of an Asthma, who was wont to cleanse Feathers for Beds, whose Lungs were stuff'd full of the Dust that usually gathers among those feathers."

The foregoing description is of interest when the year in which the observation was made is taken into consideration.

The Railroad Employee with Heart Disease

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IN THE cases of most patients, the question of the degree of functional activity best for disordered organs, is one of very great importance. In many diseases activity must be conspicuously reduced, while in many others, at least in certain stages, it is appropriately increased. In either instance, the proper level of work becomes an important consideration for correct therapy. It is with the problem of the correct level of physical activity in railroad employees with heart disease, that this paper is concerned.

Read before the Twelfth Annual Meeting of the MEDICAL ASSOCIATION OF THE MISSOURI PACIFIC RAILROAD, St. Louis, Missouri, March 26, 1941.

According to the appropriate degree of physical activity, the Nomenclature and Criteria for Diagnosis of Diseases of the Heart, adopted by the American Heart Association, puts a cardiac patient into one of five classes.

In Class A are those patients whose physical activity needs no restriction.

In Class B are those who need no restriction of ordinary physical activity, but who should be advised against unusually severe effort.

Class C is composed of those who need some restriction even of ordinary activity.

Class D comprises patients whose ordinary physical activity must be greatly reduced.

In Class E are those who should be at complete rest.

Before deciding into which of these classes a patient belongs, i.e., before reaching a proper "Therapeutic Classification" so far as activity is concerned, various data must be taken into account. A very important consideration is the degree of physical activity that can be tolerated without discomfort, i.e., the "functional capacity," as the Criteria calls it. Four classes of patients divided on the basis of functional capacity are given:

In Class I are those who experience no discomfort on ordinary physical activity. They have neither pain nor dyspnea.

In Class II are those patients who experience discomfort of some sort even on ordinary physical activity. This may take the form of dyspnea, undue fatigue, or pain. In other words there may be cardiac insufficiency or angina.

Class III is comprised of patients who are comfortable at rest, but experience discomfort on less than ordinary activity.

Class IV comprises patients who are uncomfortable even at rest.

It is obvious that this "functional" classification must depend almost entirely upon the history. It is the extent of the symptoms that determines functional classification, not the presence or absence of physical signs. A patient whose capacity for physical activity is conspicuously limited because of discomfort that arises on less than ordinary activity is put in functional capacity class III, whether he exhibits abnormal physical signs or not.

It must be kept in mind furthermore that a determination of functional capacity is not the only requisite for correct therapeutic classification. Other considerations, such as the anatomical and the etiological diagnoses, may be very important. A patient convalescing from a recent infectious disease, for example, might experience no symptoms on ordinary activity, and consequently be put in functional capacity class I; but, for a time at least, as a protective measure, his doctor, keeping in mind the etiological diagnosis, might put him in therapeutic class C or D. A man with an

aneurysm might be without symptoms of any sort, but this fact would not place him in therapeutic class A. Regard for the anatomical diagnosis would give him a lower classification.

IN THE cases of railroad employees, proper advice with respect to activity must take into account also still another factor not considered in the Heart Association's Criteria for Diagnosis. It is not enough for the doctor to know the *quantity* of work involved in the patient's occupation; he must know the *quality* of it. His advice must consider not only the question of harm to the patient but also the question of injury to others.

The obligation of the physician in private practice always is primarily to the patient, the doctor-patient relationship being confidential. It is true that the private physician must not offer advice contrary to law, and his advice to the patient must not conflict with the public interest; but such considerations are secondary. His responsibility is to the patient. His advice is for the patient's welfare.

The public health physician, on the other hand, is concerned with the welfare of the community. Public welfare comes first, even though it involve some inconvenience to the individual. The physician cannot make or enforce regulations that work undue hardship on the individual, but his regard for the individual is secondary, his primary obligation being to prevent injury to the public.

In the complexities of modern industry both viewpoints are essential. The industry must not hurt the individual, the individual must not hurt the industry or the public. The advice of the physician to the railroad employee with heart disease regarding his activity must consider the patient's welfare. He must not be allowed to injure himself. This advice, this therapeutic classification of the patient, must keep in mind also the obligation not to allow injury to others. In most instances these viewpoints in no wise conflict.

In this connection it should be noted that correct therapeutic classification may be influenced by the history of certain clinical syndromes, with or without associated discomfort, and with or without accompanying evidences of heart disease. A patient with a history of Adams-Stokes attacks must be protected from injury to himself. If his work is such that a fainting attack might cause injury to others, he must be given a work classification with that fact also in mind. The same considerations apply to an employee with dizziness or fainting attacks due to hyperirritability of the carotid sinus.

The more common syndrome of cardiac insufficiency (so-called congestive heart failure), on the other hand, is less likely to be associated with sudden attacks of unconsciousness. In uncomplicated cases of cardiac insufficiency, consideration properly is directed primarily to the patient himself. An employee with the congestion and dyspnea of cardiac insufficiency must receive a low therapeutic classification because of his very inability to do hard work. In some such cases there may be relatively few signs referable directly to the heart. During a period of improvement from inactivity, it might be a matter of great difficulty to determine the low level of functional capacity that soon would become apparent under the test of physical work. Here again the history of previous failure may be the all important item. For example, a man with early congestive heart failure might find his work too hard for him, and might have to be relieved of duty. After an interval of rest he might present very few evidences of the cardiac insufficiency that had made it impossible for him to continue his work. The history, however, in most cases, would make it very unwise to assign him again to a therapeutic classification which experience had shown him incapable of maintaining.

Many patients with angina pectoris present few evidences, physical, roentgenological, or electrocardiographical, of the coronary artery disorder responsible for their symptoms. As a general rule in the cases of patients with angina who are not altogether incapacitated, it is my feeling that, all things considered, the welfare of the patient is served best by encouraging him to continue in his occupation, and by helping him to modify his work and adjust himself to it, so that, in many instances, he is enabled to carry on as effectively as before the onset of symptoms. The psychic and the physical aspects of disease cannot be sharply separated, nor can the psychic and the physical details of therapy. Encouragement is good therapy. Sudden death in angina is always possible, a consideration emphasized since the time of Heberden. To the patient, however, should be emphasized the other possibility,—the possibility of continuing at work indefinitely and even of becoming symptom free.

In the cases of many patients with angina, or with other syndromes that presuppose the possibility of sudden death or of unconsciousness, the risk of injury to any considerable number of other people is but little increased by allowing the patient to continue at his usual occupation. If his work involves no particular increase of the factors which precipitate his attacks, therefore, the patient may well be encouraged to continue at it. But in the case, for example, of a trainman, a dispatcher, or a switchman on the main line, primary obligation to the patient obviously cannot supersede obligation to the public welfare.

The Effect of Trauma

—With Relation to Tuberculosis, Pneumonia, Pernicious Anemia, and Related Conditions—

ARTHUR H. TERRY, JR., M.D.,
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TRAUMA defined, according to Liddell and Scott's Greek dictionary, means a wound or injury. This is enlarged in Webster's unabridged dictionary to include the resulting condition and also to include psychic trauma or mental

Read before the Association of the Bar of the City of New York, January 28, 1941.

shock or any disturbing experience to which a neurosis may be traced.

There are several kinds of trauma; first, direct; second, indirect; and third, psychic.

Examples of direct trauma might be straight blows, injuries, stab wounds, heat, cold, gas, electricity, or injury due to any of the elements.

Indirect trauma might be led to include trauma which results in a blood embolism which might be formed at the site of injury and carried on to the lung, or a fat embolism which might be formed at the site of injury and carried on to the lung, or the entrance of air in the blood vessels at the site of the injury and carried on to the lung or elsewhere.

Psychic trauma is, as the term implies, more of a mental and nervous affair causing a certain amount of shock which may do immediate damage or lead on to general body disability with loss of appetite and loss of weight and so bring about a condition of susceptibility to disease. When disease follows injury, either soon or late, one must consider whether this onset of disease is pure coincidence or whether the logic is *post-hoc-ergo-propter-hoc*, or whether there is any undue exaggeration of symptoms one way or another, particularly expectation of continued insurance policies; also, whether following the injury there are so-called bridging symptoms such as a continued cough up to the onset of disease. Many diseases may be the cause of the trauma, so that it is difficult to distinguish the cart from the horse—which is cause and which is effect.

THE first disease to be considered is pneumonia which may be regarded as an inflammation of the lungs with consolidation of a portion of the lung due usually to infection and running an acute course. Example of various types of traumatic pneumonia follow:

The first case was an Irishman, 51 years of age, admitted to our hospital following a brawl in which he was struck in the right chest three days prior to admission. This was immediately followed by a severe pain in the chest, shortness of breath and cough and the immediate onset of blood-streaked sputum which continued for three days following the injury and up to his admission to the hospital. On examination, there was found an acutely ill man with a low blood pressure and fever and a contusion over his right chest and signs of pneumonia over his right chest which was verified by x-ray, and a marked friction rub over the right chest signifying an underlying pleurisy. No fracture of the ribs. Type 1 pneumococcus in the sputum. Treated with sulfapyradine and the usual methods, and he became steadily worse and died. Autopsy revealed no signs of rib injury but localized pneumonia and pleurisy beneath the site of the blow. This type of case is rare, as is all such direct traumatic pneumonia, but it would seem probable that the local blow caused a local pleurisy and a local congestion of the lungs as evidenced by the immediate bloody expectoration. Then followed infection of the congested area, consolidation and typical traumatic pneumonia. The meat in this case, to my mind, is the immediate and continued spitting of blood-streaked sputum.

The second case is also an example of direct pneumonia due to submersion. Another Irishman, drunk, on the end of a pier, fell overboard and was immediately brought to the hospital with an alcoholic breath and was found to be semi-conscious, chest full of rales, subsequently developing signs of right upper lobe pneumonia which x-ray confirmed, treated in the usual fashion with sulfapyradine and making an uneventful recovery despite his unfortunate experience. This case probably represented an aspiration pneumonia combined with the luck of the Irish. All cases do not terminate so favorably as this one. How do we know he was drunk? Well, he had an unusually strong alcoholic breath with his Hibernian accent. How do we know that he didn't have pneumonia and become delirious and plunge overboard? Well, we don't, but more Irishmen prefer a fight than a bath.

Another example of somewhat more indirect pneumonia that I saw in the hospital the other day was that of a young man who fell down an elevator shaft fracturing his acetabulum and driving the hip bone into his pelvis. When he came to the hospital, his lungs were clear and his temperature normal. When I examined him a few days later, he had a typical lobar pneumonia and an absolutely irregular heart; a series of circumstances which would lead one to believe that the fall down the elevator shaft may have caused not only his ensuing pneumonia but also his acute auricular fibrillation or cardiac irregularity, as both these conditions promptly became normal under proper treatment. How this pneumonia was brought about, it would be more difficult to state; whether it was due to direct trauma of the chest, causing local contusion, or whether it was due to the fact that he, too, was alcoholic but not Irish, and so from his fall down the shaft rendered more susceptible to the pneumonia. However, I would feel reasonably certain that his severe injury was the cause of shock, plus acute cardiac irregularity, plus the onset of an acute pneumonia three days after entering the hospital.

Another more indirect pneumonia was a case seen in the hospital in December. A man on a convoy from England, attacked by a pocket battleship, was out in an open boat for 48 hours, picked up by a British steamship, taken to Nova Scotia and 12 days later brought to Beekman Street Hospital, because of chill, fever and pneumonia. No direct trauma about this, but a long history of exposure to the elements rendered him more susceptible and a typical case, in my opinion, of indirect traumatic pneumonia. A friend of his on the same boat, but in a different lifeboat, exposed to the elements for five days developed acute tonsillitis at the same time. Both patients, though acutely ill, recovered. Their story of exposure was extremely interesting, and their sentiments regarding Herr Hitler's responsibility for their acute illness left no doubt in my mind but that this

was, indeed, a true pocket-battleship pneumonia.

I won't mention any more detailed cases of pneumonia, but certainly those cases occurring following leg injuries, where there is later thrombosis of a leg vein and subsequent sudden onset of lung infarction due to the breaking off of some of this thrombosis, would be undoubted pneumonia or pulmonary infarct on a traumatic basis.

Hypostatic pneumonia, as you know, is pneumonia developing following severe injuries, particularly in old people where they have to lay up in bed for a long time, bringing about poor circulation in the lungs and stasis in an area of lung susceptible to the pneumococcus. Fortunately, with renewed care there are few such cases. In the last two years, examining 50 cases of broken legs in our hospital, there were no such pneumonias.

Other examples of traumatic pneumonia would be stab wounds, penetrating wounds and any kind of a wound entering through the chest wall so as directly to injure the lung or cause bleeding into the lung or pleural cavity. Pneumothorax and hemothorax: these cases are so self-evident as to be less interesting. A patient of mine held his breath, turned on an icy shower bath, felt a sudden pain in his side and collapsed with leak in his lung and air in his chest — and no tuberculosis either. Dramatic but not controversial; therefore, not legally interesting.

TUBERCULOSIS, on the other hand, may involve any organ. First, it may involve a bone or joint, and an example of traumatic tuberculosis recently in our hospital follows:

A young man, aged 30, two months ago slipped and fell on his right shoulder, and suffered immediate tenderness and pain. The pain persisted and was associated with difficulty in motion. On physical examination there were shown to be signs of inflammation, and x-ray revealed a destructive process of the right acromioclavicular joint. Lungs normal. This patient was discharged from our hospital, and a month later died of tubercular meningitis. This chronological sequence of events would lead one to presume that the injury was the immediate cause of localized tuberculosis which subsequently entered the blood stream causing a generalized tuberculosis and ultimately meningitis and death. It would not be presumed that the tubercle bacilli were forced into the joint but that the injury to this joint made that local area susceptible to tubercle bacilli already in the patient's body although there was no evidence of such in the patient's lungs. Ninety per cent of the people have TB lesions.

Another patient, aged 42, a steam fitter, sustained multiple injuries when he slid down a six-story chute. Fractures were given appropriate treatment in the hospital, but an elevation of temperature occurred with slight cough and sputum positive for tuberculosis. X-ray disclosed a fracture of the left arm and bilateral pulmonary tuberculosis. This is the kind of case open to argument, because we have no x-ray evidence that the patient's lungs were normal before injury and all we know is that, during the course of convalescence, active tuberculosis became prominent in the lungs and the presumption would be that the trauma was the cause of aggravation of a pre-existing tuberculosis of the lung. It would be splendid if everyone had an x-ray record of lungs before and after injury, but even this would be insufficient to determine whether or not trauma was the etiological factor. If pulmonary tuberculosis follows an injury too soon, then the tuberculosis was probably old stuff—if it occurs too late, say after one year, then the injury should probably be outlawed, and I don't see any way to determine the answer except by presenting conflicting medical opinion to an impartial arbiter.

A more remote case of pulmonary tuberculosis occurred in a patient of mine who in January, 1940, was quite well and happy in her work. In February she was informed that she was no longer needed to teach school. In other words, in June she was to be without a job. This, she says, caused her great shock, as she had never been criticized about her work and she was under the impression that she was doing a good job. From then on she worried, and tried to get another position, but eventually lost weight and was discouraged. In April she developed a pain on her left side when she took a deep breath. She didn't give in to it for a week, finally consulted a doctor who sent her home to bed with a diagnosis of acute pleurisy, and x-ray revealed underlying pulmonary tuberculosis. She remained in bed all summer and this fall the tuberculosis is at least temporarily healed. The case is cited as an example of psychic trauma bringing about mental discouragement and inanition and all those conditions deplored by the patient but most favorable to the tubercle bacillus. Such is the effect of traumatic shock. It is true this patient has a TB sister, but no recent exposure and never before sick herself, so it looks as though misfortune here initiated pulmonary TB.

THE last subject, pernicious anemia, is certainly more controversial. In this disease, we are dealing with a situation brought about by a deficiency factor in the body. What that deficiency factor is no one knows, but in the stomach there is some factor which, added to normal digestion, brings about the normal life cycle of the red blood cells. It is difficult to see how any trauma, direct in nature, can cause pernicious anemia, when there are so many gastrectomies performed without incurring real pernicious anemia. A few cases simulating pernicious anemia have been cited but never the real thing. The only evidence that pernicious anemia can be activated by trauma is the fact that such a good man as Murphy, of Boston, in reporting his series of cases, noted that a number of these cases developed following acute mental shock of one kind or another, such as financial reverses, operation or prolonged illness; but this doesn't prove for a minute that the pernicious anemia was caused by mental shock. Most people have mental shocks without developing pernicious anemia. Also, it is a well-known fact that perni-

cious anemia tends to run in certain families, and there is already present presumably a blood set-up all ready to break, and the most that might be said was that the acute onset of pernicious anemia might have received enough assistance from the mental shock to let the onset appear this week instead of next.

Therefore, in reviewing the situation, no one has been able to bring about pernicious anemia in an operative way or in any other way, and it is unlikely that this condition is caused by anything except a deficiency factor. Allied diseases, such as secondary anemia, of course, can be caused by trauma, because secondary anemia can be due to any one of a number of things, as loss of blood, infection, poisons, etc., and so any condition causing chronic loss of blood could bring about a secondary anemia, but this has nothing to do with primary or pernicious anemia. Some leukemias, where there is a great increase in white blood cells, are said to be initiated by bone injury. But here, too, the examples are few and feebly supported. Attempts to bring this condition about in animals by experimental fracture have failed. Aplastic anemia has undoubtedly been caused by irradiation, but that's a bird of another feather. So are the anemias caused by drugs—gold, arsenic, phosphorous, neosalvarsan, and other heavy metals. Pure coincidence is the probable role of trauma in pernicious anemia.

I have undoubtedly over-emphasized trauma as a cause for all these diseases—at most, it is only the initiating factor, the predisposing factors being hereditary, habits, etc.; the real cause, the pneumococcus, streptococcus and tubercle bacillus and company, plus the X or "P.A." factor in pernicious anemia and then along comes trauma to administer the *coup de grace*. If that's the kind of guy you are looking for, there he is with dagger poised, waiting for his defenseless victim, tired out, worn out, ill prepared, and welcoming a stab in the back.

Diátriba de Morbis Artificum of Bernardino Ramazzini

A Review by

LEOPOLD VACCARO, M.D., F.I.C.S.,
Philadelphia, Pennsylvania

I DO not intend in this essay to set up a complete treatise of diseases, to describe the curative methods and a long series of remedies, but I only want to present to the practitioners of medicine a few advices that they might more easily treat the workers." With these words Ramazzini modestly appraised his *diátriba de morbis artificum*.

In his era he did not have the assistance of chemistry, physiology, anatomy or bacteriology to determine the etiology of disease. The autopsies were scarce, although a few years after the publication of the "treatise on the diseases of tradesmen" the great Morgagni confirmed by necropsy the lesions which Ramazzini had described by their clinical manifestations. "I wished," he says, "to have opened the cadaver of some chalk worker but neither a request nor money can induce the people of Modena to permit the opening of the bodies of those who die from an extraordinary disease. It is resentful against the physician who makes the request for the public good and considers the investigation of the cause of disease, unrecognizable otherwise, as a useless curiosity."

Industry as we know it now, was then in its infancy. The medical opinions were largely erroneous. The system of treatment was mostly based on blood letting and purgation. The patients were all being treated alike medically with no regard to constitution or resistance. No thought was ever given to the occupation of the patient. Against this error Ramazzini observes: "The duty of the physician to these patients is to rehabilitate them as quickly as possible, administering them strong and appropriate remedies because those wretched persons often beg the physician to give them either death or a prompt cure. It is important, therefore, to treat the diseases of tradesmen by accelerating the cure, following this way the same precepts of the divine Plato. There are some practitioners," adds Ramazzini, "who, on the ground of a despicable custom, prolong the recovery of certain diseases, which nature would have cured in a far shorter period of time."

Referring to public health and industrial hygiene, he observes: "The ancient founders of cities and their legislators caused to be erected, by enormous expenditures and with real magnificence, public baths in cities and towns. This they did not only for the luxury and fastidiousness of those women and men who carry everywhere their haughtiness, but also for the convenience of the tradesmen, so that these worthy men, with a small fee, might remedy their habitual filthiness and at the same time restore their bodies from the fatigue arising from their tasks."

Ramazzini tried to popularize public baths which flourished in pagan Rome and were condemned by the Christians because of scandals and abuses. He points out how the legislator preceded the physician in the protection of the working men. The economic and juridical protection historically preceded the hygienic protection. In fact, he says, "those who erected cities and laid the foundation of kingdoms, had the greatest care of the workmen that inhabited them and were organized into colleges or communities — Numa Pompilius acquired unusual glory, as told by Plutarch, for separating the tradesmen according to their trade and for having grouped in various bodies the architects, the players of the flute, the gilders, the dyers, the tailors, the tanners, the coppersmiths, the potters, etc. Appius Claudius and Publius Servilius, consuls, according to Titus Livius, constituted a college of mercuriales or guild of merchants, so called after their god, Mercury. Such communities of tradesmen were accorded rights and privileges, were given suffrage and raised in dignity and, therefore, counted among the citizens of Rome.

They were permitted, according to Julius Caesar, as a kind of Republic, to negotiate among themselves, to select representatives and to formulate laws, just so they did not run counter to the public laws.

"Since, therefore, in the well established cities," continues Ramazzini, "laws were always passed and are being passed to regiment labor for the good of the tradesmen, it is proper that for the benefit of these men held in such high esteem by the law, the practitioners of medicine, animated by their particular zeal, which was not heretofore demonstrated in regard to workers, should supervise the workers' health and should exercise with more determination and less fear the art that each practices."

IN THE *de morbis artificum*, Ramazzini makes ample citations of the opinions of other authors among the Greeks and Romans, especially Hippocrates, Socrates, Aristotle, Plato and Galen. He was 70 years old when he completed his treatise. The newness of the subject, the difficulties of handling the enormous amount of work necessitated a consultation of all that had been written before him on this very topic. He consulted the writings of historians and economists, and studied the various important periods of history. Plant visitations were carefully carried out and long conversations held with the humble workmen to get an insight into their ailments. He states that there were two principal causes of the many diseases suffered by the workers. The first was the particular substances they came in contact with and their toxic emanations. The second he ascribed to the violent and disordinate movements and the harmful postures to which the workers were subjected.

It appears obvious that with an analytical and synthetic mind he recognized all the main causes of disease among the tradesmen, such as the materials used in the various processes, the occupational environment, the excessive work and the prolonged and harmful postures.

In the first chapters, he deals with the deleterious substances handled by the workers and the unsanitary surroundings. He starts with the miners, whose lot has been so bad from times immemorial, so that to this type of work, among the Romans, were assigned only the slaves who had one half of the scalp shaved to distinguish them from the fugitives, wholly shorn of their hair.

The early Christians were sentenced by the Roman emperors to this punishment because of their religious profession. As told by Agricola, in the Carpathian mines there were women who had been widowed as much as seven times, because their husbands all died young (from silico-tuberculosis).

Ramazzini thus describes these men: "They looked more like shadows than men to whom medicine did more harm than good since it prolonged their wretched existence."

Describing the diseases of the miners, Ramazzini presents a synthetic picture of mercury poisoning, lead intoxication, and other noxious emanations. After the miners, he deals with other workers exposed to the same action by other metals. He refers to the excessive heat of the kilns, to which were exposed the gilders, potters, coppersmiths, glass workers, iron workers and the makers of mirrors, etc.

Apropos of the painters, he describes the harmful effects of mercury and lead, and the painter's colic is foreshadowed although he makes no special mention. This indicates that he was not acquainted with the work of Stockusen who, 44 years before, had written on this subject. In fact Ramazzini confines himself to the famous story of the painter of Angers, who after tremor of the hands, had convulsions of the arms and then legs and such violent abdominal pains that in order to calm them it was found, as a good remedy, to have three or four men lie on the poor wretch's abdomen!

Ramazzini then treats of the harmfulness of dust and of the changes in temperature of the chalk workers, furnace workers, millers, quarry workers and stone cutters, and carders of hemp, linen and silkworm cocoons. With reference to the disease of bakers which was very common in his day, he gives this description: "They all look crooked on the exterior and their feet resemble the claws of crabs and lizards, on account of the position of their feet on the staff with which they press the dough." This disease has now disappeared because of technical improvements in mechanical kneaders.

Ramazzini advises workers engaged in dusty occupations to work in spacious places and, in the absence of the modern exhaust ventilators, to turn their back toward the wind so not to inhale dust; to wash often the face and mouth and to abandon their jobs when menaced with incipient tuberculosis.

We pass next to the diseases due to irritating gases, such as workers exposed to sulphur, and cesspool cleaners—an occupation assigned to law breakers by the ancient Romans. These workers all became blind and beggars "because of a volatile acid which escapes from the cesspool and attacks the eyes." The lack of knowledge of chemistry did not permit Ramazzini to indict hydrogen sulphide.

Another occupation which had an irritating gas exposure, was that of the fuller, a type of worker who, since ancient times, was engaged in the cleaning of wool and clothes by using putrid urine. Because of the great use of urine among the Romans to cleanse clothes and dyeing of purple cloth, there were some special receptacles distributed throughout the cities to receive urine. It was for this reason that Emperor Vespasian imposed a special tax on urine. This custom was prevalent in Rammazzini's time. The workers mixed urine with warm water and soap in hot unventilated rooms and as a result they became cachectic and asthmatic.

In the same category of workers exposed to fetid odors, we note the workers of oil made from walnut, tanners, cheese makers, candlemakers and sextons (morticians) to whom he dedicates a special chapter with this humorous statement: "It is only fair that medicine should render some reward

to a group of men who conserve our dignity by burying with the cadavers the errors of the medical practitioners."

The lot of these men in entering the large public tomb with packs of putrified human bodies was so wretched that their occupation, as that of the miners and cesspool cleaners, was reserved only, since ancient times, to public slaves.

Next to the sextons who close the curtain of life, Ramazzini treats of midwives who raise the curtain of life, who at the time of delivery may be infected by the discharges of the lying-in woman. In those days there was no knowledge of the asepsis and antisepsis which have eliminated these dangers. The midwives were followed by the mercenary wet nurses who, in the process of nursing, were subject to many diseases now very infrequent.

Ramazzini then treats the effects of inebriety and professional drunkenness, and the ill effects produced by the odors of wine in fermentation among the workers thereto exposed.

From the exposure to noxious gas and dusts, excessive heat, etc., Ramazzini reviews diseases arising "from bad postures of the body, as happens to those wage earners who work standing tilted, curved and engaged in horsebacking or any other uneasy position." We have here the bad effects of a prolonged erect station, sedentary life, and fatigue. He mentions the carpenters, the sculptors, the foundry workers, bricklayers and masons, those standing erect for a long time, and he refers to the development of varicosities. He mentions the servants and courtiers of the Court of Spain who suffer from backache and stomach ailments through long hours of standing on their feet, because chairs were not in use in those days.

"It is necessary to alternate movements," he says. "Nature demands it. The Israelites after eating manna from Heaven for a long time in the desert, had a desire for the garlic and onions of Egypt."

Likewise harmful was the sedentary life of the cobbler, the tailors, and those who worked with the body semiflexed, becoming stooped and kyphotic. He says, "It is a spectacle in certain annual fiestas to see groups of tailors and shoemakers parade two by two or to assist at a funeral procession of one of their confreres. They present a crowd of hunchbacks, hubblers, as though they had been particularly chosen to excite laughter and merriment."

From this category we now pass to diseases resulting from over-exertion of the postillions and the runners who at one time were forced to run ahead of the horse carriages of the lords; an occupation now reserved for dogs. Plinius states that the spleen of the runners was burned so that it would not swell in the performance of their duties. Ramazzini describes the effect of fatigue in porters or stevedores, and the athletes, whose physical feats were held in high esteem not only by slaves but noble people as well.

We next note the harm done to vision in workers engaged in the making of small objects, such as watch makers, artists of precious stones, professional writers, etc. Ramazzini studies the damages from the inclemency of weather and the hardships of the farmers and fishermen. He takes note of the diseases resulting from humidity and the dirt of the laundry affecting the washwomen. Finally, he treats of the diseases of armies and the ravages of pestilence of those who escaped slaughter on the battlefield.

There follows a supplement of 12 chapters which Ramazzini added to the second edition published in 1713. In this supplement, he treats some of the occupations omitted in the first edition. The first chapter is dedicated to the diseases of printers. He deals with diseases of mariners, hunters, soap workers, etc. These chapters are more concise and the references fewer. The style and form are not much changed.

Ramazzini's DE MORBIS ARTIFICUM written in Latin had 25 editions and many foreign translations. In recent times much progress has been made in industrial medicine, but Ramazzini is still looked upon as the Father of this new discipline.

Industrial Health

—Virginia Symposium—

DR. FRED J. WAMPLER, Professor of Preventive Medicine, Medical College of Virginia, sends the following program for the SECOND SYMPOSIUM ON INDUSTRIAL HEALTH to be held in the Simon Baruch Auditorium at the Medical College of Virginia at Richmond, September 11 and 12, 1941. All who are interested are invited to attend; there will be no registration fee.

Program

THURSDAY, 9:30 A.M.—WILLIAM H. HIGGINS, M.D., Professor of Clinical Medicine, presiding.

"The Medical Society of Virginia's Program for Industrial Health." WALTER B. MARTIN, M.D., President, Medical Society of Virginia, Norfolk.

"The State Board of Health's Bureau of Industrial Hygiene—Assistance It Can Render the Industrial Physician." J. B. PORTERFIELD, M.D., Director, Bureau of Industrial Hygiene, State Health Department, Richmond.

"Tuberculosis in Industry—the Use of Mass X-Raying." E. C. HARPER, M.D., Tuberculosis Control Officer, State Health Department, Richmond.

"How an Industrial Physician Can and Should Cooperate with the General Practitioner." RUSSELL R. JONES, M.D., Medical Director, Western Division Bell Telephone Company of Pennsylvania, Pittsburgh.

"Respiratory Diseases and Air Conditioning." W. J. MCCONNELL, M.D., Assistant Medical Director, Metropolitan Life Insurance Company, New York.

"Diagnosis, Treatment and Prevention of Industrial Dermatoses." LOUIS SCHWARTZ, M.D., Medical Director, Office of Dermatoses Investigations, National Institute of Health, Bethesda, Maryland.

THURSDAY, 2:00 P.M.—ROBERT H. COURTNEY, M.D., Professor of Ophthalmology, presiding.

INDUSTRIAL OPHTHALMOLOGY:

"Essentials of First Aid and Later Management of Industrial Eye Injuries." HARRY B. STONE, M.D., Roanoke, Virginia.

"The Handling of Chemical Burns of the Eye." GEORGE H. CROSS, M.D., Chester, Pennsylvania.

"Detection and Control of Defective Vision in Industry." RUDOLPH C. THOMASON, M.D., Assistant Professor of Ophthalmology, Medical College of Virginia, Richmond.

"Protective Equipment for Eyes in Industry." C. N. SCOTT, M.D., Nitro, West Virginia.

THURSDAY, 8:00 P.M.—FRED J. WAMPLER, M.D., Professor of Preventive Medicine, presiding.

"The Significance of Industrial Health in National Defense." PROFESSOR PHILIP DRINKER, Professor of Industrial Hygiene, Harvard University, Boston.

"Aging as a Problem of Industrial Health." EDWARD J. STIEGLITZ, M.D.

FRIDAY, 9:00 A.M.—T. DEWEY DAVIS, M.D., Assistant Professor of Medicine, presiding.

"Medical Control of Industrial Exposure to Toxic Chemicals." JOHN H. FOULGER, M.D., Director, Haskell Laboratory of Industrial Toxicology, Wilmington.

"Placement of the Worker." T. LYLE HAZLETT, M.D., Professor of Industrial Hygiene, University of Pittsburgh, and President, American Association of Industrial Physicians and Surgeons, Pittsburgh.

"Backache." H. PAGE MAUCK, M.D., Professor of Clinical Orthopedic Surgery, Medical College of Virginia.

"The Selection of Heat in the Treatment of Plant Injuries." MURRAY B. FERDERBER, M.D., Research Fellow, Department of Industrial Hygiene, School of Medicine, University of Pittsburgh, Pittsburgh.

FRIDAY, 2:00 P.M.—I. A. BIGGER, M.D., Professor of Surgery, presiding.

Subject to be selected. PROFESSOR DONALD E. CUMMINGS, Director, Division of Industrial Hygiene, University of Colorado School of Medicine and Hospitals, and President of American Industrial Hygiene Association, Denver.

HAND INJURIES:

"Newer Antiseptics." THOMAS BEATH, M.D., F.R.C.S., Associate in Surgery, Medical College of Virginia.

"Importance of Purposeful Splinting Following Injuries to the Hand." HENRY C. MARBLE, M.D., Boston.

"Prevention and Treatment of Hand Infections." SUMNER L. KOCH, M.D., Associate Professor of Surgery, Northwestern Medical School, Chicago.

Railway Surgeons

—Fifty-Second Annual Meeting—

THE AMERICAN ASSOCIATION OF RAILWAY SURGEONS announces the following program for its Fifty-Second Annual Meeting at the Palmer House, Chicago, September 8, 9, 10, 1941.

The participating Surgical Departments include those of the Alton, Santa Fe, Baltimore & Ohio, Canadian National, Burlington, Great Western, Milwaukee, Rock Island, North Western, Erie, Grand Trunk, Illinois Central, Soo Line, New York Central, Nickel Plate, Pennsylvania, and Union Pacific Railroads, together with the Pullman Company and the Railway Express Agency.

The Local Committee of Arrangements consists of DRS. G. G. DOWDALL, D. B. MOSS, T. R. CROWDER, I. S. CUTTER, O. H. HORRALL, and E. C. HOLMBLAD, together with DR. T. L. HANSEN, Chairman of the Program Committee, all under the chairmanship of DR. A. R. METZ.

Monday Morning, September 8

9:00–10:00 Registration—Visiting Exhibits.

10:00 "Discussion and Demonstration of Treatment of Painful Backs due to Myositis, Fascitis, and Neuritis."—DR. JAMES F. DEPREE, *Assistant to Chief Surgeon, C. M. St. P. & P. Railroad,* Chicago, Illinois, and DR. JOHN E. NILSON, *Physiotherapist,* Chicago, Illinois.

10:20 "The Treatment of Burns."—DR. STANLEY J. SEEGER, *Consulting Surgeon, C. M. St. P. & P. Railroad,* Milwaukee, Wisconsin.

10:40 "Continued Disability Following Cholecystectomy—Explanation and Management."—DR. R. RUSSELL BEST, *Associate Professor of Surgery, University of Nebraska Medical School,* Omaha, Nebraska.

11:00–11:30 Intermission to Review Exhibits.

11:30 "Pitfalls in Interpretation of X-Ray Films of Bone Lesions."—DR. JAMES T. CASE, *Consulting Roentgenologist, C. B. & Q. Railroad,* Chicago, Illinois.

11:50 "The Heart in Industry."—DR. J. ROSCOE MILLER, *Consulting Internist, C. B. & Q. Railroad,* Chicago.

Monday Afternoon, September 8

12:00– 2:00 Noon-Intermission.

2:00 "Chemo-Therapy—Sulphonamide Group."—DR. M. HERBERT BARKER, *Associate Professor of Medicine, Northwestern University Medical School,* Chicago.

2:20 "Tendon Suturing."—DR. SUMNER L. KOCH, *Associate Professor of Surgery, Northwestern University Medical School,* Chicago, Illinois.

2:40 "Fractures of Both Bones of the Leg."—DR. ALFRED J. BROWN, *Surgeon, C. & N. W. Ry.,* Omaha, Nebraska.

3:00– 3:30 Intermission to Review Exhibits.

3:30 "Results of Periodic Physical Examinations."—DR. R. M. GRAHAM, *Chief Medical Examiner, Pullman Company,* Chicago, Illinois.

3:50 "Innomino - Abdominal Amputation with Report of a Case."—DR. A. H. WHITTAKER, *Detroit Area Surgeon, Railway Express Agency, Inc.,* Detroit.

4:10 "Radium Treatment of Angiomas." Motion Picture in Color.—DR. FRANK E. SIMPSON and DR. J. ERNEST BREED, Chicago, Illinois.

Tuesday Morning, September 9

9:00–10:00 Registration—Visiting Exhibits.

10:00 "Carpal Injuries."—DR. JAMES J. CALLAHAN, *Consulting Surgeon, Illinois Central System,* Chicago.

10:20 "Repair of Facial Injuries."—DR. JOSEPH E. SCHAEFER, *Consulting Oral and Plastic Surgeon, Illinois Central System,* Chicago, Illinois.

10:40 "Arteriosclerotic Vascular Disease."—DR. CARL A. JOHNSON, *Associate in Medicine, Northwestern University Medical School,* Chicago, Illinois.

11:00–11:30 Intermission to Review Exhibits.

11:30 "Hiatus Hernia."—DR. N. C. GILBERT, *Consulting Internist, C. R. I. & P. Railway,* Chicago, Illinois.

11:50 "Skull Fractures and Brain Injuries—Report of a Nationwide Survey — 1935-1940." — DR. HARRY E. MOCK, *Consulting Surgeon, C. R. I. & P. Railway,* Chicago, Illinois.

Tuesday Afternoon, September 9

12:10– 2:00 Noon Intermission.

2:00 "Peptic Ulcer."—DR. W. J. WALKER, *Assistant Surgeon, A. T. & S. F. Railway,* Topeka, Kansas.

2:20 "Skin Diseases Common to Railway Employees."—DR. E. H. DECKER, *Dermatologist, A. T. & S. F. Railway,* Topeka, Kansas.

2:40 "Fractures of the Patella."—DR. J. E. M. THOMSON, *Local Surgeon, C. R. I. & P. Railway,* and DR. CHARLES F. FERCIOT, Lincoln, Nebraska.

3:00– 3:30 Intermission to Review Exhibits.

3:30 "Newer Methods for the Repair of Inguinal Hernia."—DR. SPENCER WRIGHT, *Surgeon, Union Pacific Railroad,* Salt Lake City, Utah.

3:50 "Opportunity of Company Doctor." — DR. R. M. SHEA, *Surgeon, Union Pacific Railroad,* Denver.

4:10 "Can the Relations Between the Employees and the Examining Surgeon Be Improved?"—DR. CHARLES E. SLAGLE, *Consulting Surgeon, C. B. & Q. Railroad,* Alliance, Nebraska.

Wednesday Morning, September 10

9:00–10:00 Registration—Visiting Exhibits.

10:00 "Cardio-Vascular Disabilities of Railway Employees —Problems of the Consultant. A Review of Eight Years' Experience."—DR. HAROLD FEIL, *Associate Clinical Professor of Medicine, Medical School, Western Reserve University,* Cleveland, Ohio.

10:20 "Aseptic Necrosis of the Head of the Femur after Traumatic Dislocation of the Hip." — DR. S. W. BANKS, Chicago, Illinois.

10:40 "The Treatment of Recent Intracapsular Fractures of the Neck of the Femur."—DR. JAMES W. DAVIS, *Surgeon, Pennsylvania Railroad*, Statesville, North Carolina.
11:00–11:30 Intermission to Review Exhibits.
11:30 "Management of Traumatic Intracranial Hemorrhage."—DR. E. S. GURDJIAN, *Neuro-Surgeon, New York Central System*, Detroit, Michigan.
11:50 "Pyelonephritis."—DR. GORDON B. MYERS, *Professor of Medicine, Wayne University School of Medicine.*

Wednesday Afternoon, September 10

2:00 "The Hoke Traction Yoke in Fractures of the Humerus."—DR. JOHN W. THOMSON, *Surgeon, Baltimore & Ohio Railroad*, Garrett, Indiana.
2:20 "Infections of the Hand and Their Treatment."—DR. CHARLES F. WARD, *Surgeon, Baltimore & Ohio Railroad*, Cleveland, Ohio.
2:40 "Otoscopy in the Inflammations" and "A Clinic on Petrositis."—Sound and Color Films.—DR. SAMUEL J. KOPETZKY and DR. RALPH ALMOUR, New York.

A Five-Year Study of Arthritic Patients

—Laboratory and Clinical Observations—

ROGER T. FARLEY, HERBERT F. SPIERLING, S. H. KRAINES
Chicago

ARTHRITIS is a systemic disease of multiple etiology with protean manifestations whose course may fluctuate and be influenced by a large variety of unrelated factors. The clinical evaluation of any therapeutic measure used in the treatment of this malady is necessarily beset with many pitfalls.

The course of arthritis is known to fluctuate as a result of the variations in intensity of the many contributing etiological factors such as climatic conditions, psychic or emotional strain, excessive fatigue, dietary deficiencies or indiscretions, intercurrent infections, trauma or other systemic disturbances which directly or indirectly affect the general well-being of the patient or the metabolism of bone, cartilage or fibrous tissue.

To determine, therefore, whether any remedial agent influences the progress of arthritis, it is not only necessary to know the course of the disease from the time of its onset until treatment is instituted and the changes occurring during the period of therapy, but it is equally important to know the course of the disease after therapy is stopped.

This paper constitutes the results of a five-year clinical study in which more than 300 patients suffering from various forms of arthritis were treated with Ertron. Many of these were followed up to the present time, even after therapy was stopped.

In the study of these patients an attempt was made to follow an orderly routine of examination, recording all data and establishing the accuracy of the observations. The following general outline was used:

From a history obtained from the patient, and from the records which were available, the following data were obtained:

A. INITIAL EXAMINATION
- I. History
- II. Physical examinations
- III. Special examinations
  1. Dental
  2. E. N. T.
  3. Ophthalmology
  4. Gynecology—menstrual, sex-activity and urge
  5. Urology
- IV. X-ray of affected joints
- V. Laboratory examinations
- VI. Measurement of size of joints, swelling, etc.
  1. Fingers
  2. Wrists
  3. Elbows
  4. Shoulders
  5. Toes
  6. Ankles
  7. Knees
  8. Hips
  9. Jaw
  10. Spine
    a. Neck
    b. Back
- VII. Orthopedic
- VIII. Photographs
- IX. Gall-bladder visualization

B. PERIODIC EXAMINATIONS — during which the following factors were especially studied:
- I. Physical status
- II. Weight
- III. Appetite—nature of diet
- IV. Nausea
- V. Vomiting
- VI. Frequency of urination—nocturia
- VII. Infections—venereal and other
- VIII. Physical events
- IX. Emotional events
- X. Disability
- XI. Euphoria
- XII. Menstrual and sex activity and sex urge
- XIII. Pain
- XIV. Tenderness
- XV. Swelling
- XVI. Heat
- XVII. Color
- XVIII. Mobility
- XIX. Deformity
- XX. Dynamometer
- XXI. Other medication, especially since Ertron stopped.

At the *initial examination* a complete history was taken which included not only a detailed description of the course of the arthritic process, but also the description of all other pathological changes which occurred during the life of the individual. The family history or other facts which might in any way be related to arthritis were recorded.

The *physical examination* was complete and included a detailed search for all pathology and disturbed functions. Even when the symptoms seemed to be localized in the joint, we never failed to realize that arthritis is a systemic disease and that the symptoms localized in the articular and periarticular tissues are merely part of a symptom-complex which may involve the entire body.

The *special examinations* included searches by dental, oto-rhinolaryngology, ophthalmology, gyne-

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cology and urology specialists. A search for psychic factors was always made.

The *radiological examination* included studies of the affected joints. In some cases normal bones were also x-rayed to determine the general condition of the osseous system.

The *laboratory* examination included the following blood studies: complete and differential blood count, sedimentation rate, calcium, phosphorus, cholesterol, total protein, Kline, uric acid, non-protein nitrogen, sugar. A complete urinalysis was done on each patient.

All joints were examined and their condition was recorded, noting especially such factors as pain, tenderness, swelling, heat, color, mobility and deformity. This examination was made by the internist.

After the history, physical examination, examinations by specialists, x-rays and laboratory work were completed, a *complete orthopedic examination* was made. The orthopedic examination was so planned as to detect and study not only pathological changes in the osseous, fibrous and muscular tissues but also to measure the amount of functional impairment of the skeletal and muscular systems. The joints were measured, amount of swelling estimated and pain, tenderness, heat, color, deformity and mobility were noted.

A detailed *history of the dietary habits* of each patient was obtained. This included not only an estimation of the daily requirements of each patient and the existing deficiencies in the diet, but also a study of the condition of the gastro-intestinal tract and the ability of the patient to absorb and utilize his food.

Treatment

AFTER all the information was recorded and summarized for each patient, we outlined a definite specific plan for managing that particular case. The chronic arthritides are systemic diseases which involve not only the articulations and their surrounding structures, but also many of the other systems of the body. It is important, therefore, to attempt to elevate to maximum efficiency all the disturbed physiological processes.

NUTRITION: Optimum nutrition is very important in making such a state possible. No attempt was made to prescribe any special diet except in cases of gout. For routine use, as wide a variety of foods as was practical for the individual was recommended. We encouraged the use of whole raw fruits and green leafy vegetables to supplement the meat, fish, eggs, milk, etc. Our goal was to prescribe a diet furnishing the proper caloric content, together with adequate amounts of all known vitamins and essential minerals. Frequent observations have led us to believe that it is desirable to eliminate white flour and fatty fried foods.

No other adjuvant therapy was used except occasionally, in certain specific cases, various forms of physical therapy proved comforting to the patient. An attempt was also made to correct any existing psycho-pathology.

PSYCHIATRIC ASPECTS OF ARTHRITIS: A very extensive bibliography has developed on the influence of emotional factors on the incidence and development of arthritic symptoms. In order to study the psychiatric factors which may influence the arthritic process, selected patients included in this report were studied very carefully from the psychiatric point of view. In addition, a psychiatric study of another group of arthritic patients is being conducted.

A variety of factors play a role in the etiology of chronic arthritis. The following four factors are usually essential interacting elements:

1. Constitutional predisposition.
2. Dietary deficiencies or indiscretions.
3. Precipitating factors such as cold, wet surroundings, excessive fatigue and chronic infection.
4. Psychiatric factors.

These factors may act singularly or in combination. Arthritis symptoms develop when the multiplicant of all these factors reaches a certain level. *The reduction of the influence of any one of these factors may so lower the resultant multiplicant that the symptoms will disappear although the predisposition will still continue to exist.*

In a psychiatric study two problems warrant specific attention. First: The general personality or group of characteristics which goes to make up the type of individual most likely to have arthritis. Second: A study of the precipitating emotional factors that may evidence themselves in general symptoms which have been termed neurasthenia, but are really symptoms of tension. The type of personality varied, but a large number of patients were tense, over-reactive and of a worrying nature. Superimposed upon this tense personality, emotional factors were usually added to intensify further the person's reactiveness and to precipitate arthritic symptoms.

MECHANISM OF ACTION OF THE PSYCHIATRIC FACTORS: When a person is subject to "irritating thoughts" * there is increased tension in the cortex which in turn transmits impulses to the hypothalamus. The hypothalamus is the center of the autonomic nervous system, the posterior portion presumably being sympathetic and the anterior, parasympathetic in action. When the hypothalamic region is stimulated there result vasomotor spasm, gastro-intestinal spasm, increased heart rate and other signs. In addition, stimulation of the hypothalamus results in overactivity of the pituitary gland with which it is connected by the supraoptic-hypophyseal stalk. Stimulation of this "master" gland results in an alteration in the glandular activity in the rest of the body. As a result of this chain of activity, which originates in the cortex as an irritating idea and extends to the autonomic nervous system and endocrine glands, there results an alteration of function in the entire organism.

In those persons in whom there is a constitutional predisposition plus a nutritional abnormality, plus such factors as exposure to cold, fatigue and infection, the added psychically originated changes may precipitate an arthritic condition. These psychic factors may operate by: (1) producing tension

*This phrase is an abbreviation for the whole gamut of emotional disturbances, and a more complete discussion will be found in the Text, "The Therapy of The Neuroses and Psychoses," by S. H. KRAINES.

within the muscles and thus interfering with normal relaxation and movement of the joint surface; (2) vasomotor spasm which interferes with adequate circulation through the joint areas; (3) alteration in the general endocrine chemistry which may interfere with the normal nutrition of the articular structures. The need for adequate psychotherapy[1] as part of the general management of arthritis patients is known, but is commonly overlooked.

Medication

THE medication used in the treatment of these patients was the high potency activated vaporized sterol known as Ertron. By the special Whittier process, electrically activating the heat-vaporized ergosterol, there is imparted both antirachitic and antiarthritic properties. The finished product has properties which indicate that it may be a separate and distinct entity. This view is corroborated by the experimental results reported by Reed,[2] Snyder and Squires,[3] and others.

Although in our earlier clinical trials the average dose of Ertron used was four capsules (7.5 grains each) per day, more extensive studies indicate that the optimum results are obtained when it is administered in the maximum tolerated dosage. A convenient procedure is to start with one capsule (7.5 grains) three times a day, and increase the dose by one capsule a day every three days until six capsules a day are given. Continue giving six capsules a day.

In some cases it has proved beneficial to increase the dose above six capsules a day. This may be done, but if signs of intolerance appear (nausea, vomiting, frequency of urination, nocturia) stop the administration of the drug for about one week. After this, start again with three capsules a day and gradually increase the dose to the tolerated amount. It is advisable to have the patient take at least one glass of milk, three times a day.

Numerous investigators have studied this factor in carefully controlled clinic experiments. Reed, Struck and Steck[2] evaluated the results which they obtained in the arthritis clinic at the University of Illinois. They used as criteria of improvement, increased mobility, reduction of deformity and swelling, increased muscular strength, reduction of pain, x-rays and extensive laboratory studies.

Definite measurable improvement occurred in the majority of the patients treated with Ertron by these investigators.

Livingston[4] reported that in his hospitalized cases treated with Ertron he observed "progressive improvement has been noted in from one week to two months of treatment. The improvement was manifested by decreased pain, greater mobility, reduction of deformity, and improved muscular tone associated with increased muscular strength. The general state of health was improved. The depressed mental attitude of most of these patients was changed to that of hopefulness. The appetite returned."

Snyder and Squires[3] conducted a very carefully controlled series in which the efficacy of Ertron in the treatment of chronic arthritis was studied. In this group of cases in which there were rheumatoid arthritis, osteoarthritis, infectious arthritis, and mixed groups, great care was taken to eliminate the possibility of spontaneous remissions. No case was included in this report unless it had previously been under other treatment and observation for two years or more, it had various forms of therapy and had proved resistant to them. Each case had to be sufficiently severe to show objectively serious manifestations of the arthritic process. Motion pictures, still photographs, x-rays and orthopedic measurements of the deformity, or lack of mobility, as well as the muscle weakness, served as means of determining any alteration in the course of the arthritis. In a relatively high percentage of cases the degree of clinical improvement has been marked and sustained.

In 1938, one of us (R. T. F.) published his results obtained in a series of 87 cases of chronic arthritis treated with Ertron in private practice.[5] As a result of a very critical evaluation of the clinical observations he concluded:

"All of the patients who continued treatment for two months or longer in accordance with the prescribed management have shown considerable improvement. In most cases the improvement was so marked that it enabled these people to resume their business activities or occupations."

PERMANENCE OF IMPROVEMENT: With any form of antiarthritic therapy it is important to know not only the maximum amount of benefit obtainable, but also whether the beneficial effects persist and are permanent after therapy is stopped. In order to determine this, 18 arthritic patients who had been started on this form of treatment five years ago and who had had no treatment for varying lengths of time were studied. This present report is based on a follow-up study of these patients.

The results obtained in the present five-year follow-up study are described in detail in Chart VI. In general the beneficial effects of Ertron in altering the arthritic process are definitely demonstrated.

It is, of course, difficult to determine just what period of time should elapse before any therapeutic agent in arthritis is called a permanent cure. In this study much evidence was obtained to suggest that when Ertron is administered in optimum doses for a sufficiently long period, the disappearance of symptoms and beneficial effect produced are sustained and probably permanent, provided the patient continues to take an optimum diet and adequate rest, and avoids emotional upsets.

In some cases, as shown in Chart VI, when Ertron administration was stopped there was a recurrence of symptoms. The return of symptoms could often be traced to such etiological factors as excessive fatigue, emotional stress, or dietary indiscretions. In others, who were cooperative, even with the cessation of treatment, the patients remained in good health with normal functional activity up to the present time, which involved periods ranging up to three years. These cases prior to this medical management were all very severe and were getting worse, so that there was no question about their becoming more affected with time. The improvement must be attributed to the form of therapy used, and the absolute disappearance of the symptoms should rightfully be considered the result of the medical management of the patient.

Chart I—Cellular and Chemical Constituents of Blood

Case No.	Sex	Age	Weight	Date of Exam.	Hemoglobin	Erythrocytes Millions per c.m.m	Leucocytes Thousands per c.m.m.	DIFFERENTIAL WHITE CELL COUNT—(PER CENT)								Sedimentation Rate m.m. in 60 min.	Non-Protein Nitrogen	Calcium mg. per 100 c.c.	Phosphorus mg. per 100 c.c.	Cholesterol
								Small Lymphocytes	Large Lymphocytes	Large Monomuclear	Transitional	Neutrophiles	Eosinophiles	Basophiles	Non-Filament					
I	F.	70	134	11-15-37	75	4.43	7.00	27	1	3		58			11	13				
		74	140	3- 7-38	80	4.15	7.65	31		10		44	4		11	12				
				8-23-38	80	4.44	10.5	28		6		38	2		26	14				
				11-16-38	80	4.26	7.6	37		3		49			11	9	36.5	9.51	3.11	235
				2-28-39	80	4.16	10.15	36		2		46	1		15	11	37.5	9.90	3.02	260
				12- 6-40	93	4.88	6.8	46		1		52	1		11	10		9.30	3.19	271
II	M.	37	177	11-13-37	90	4.78	7.60	30		6		60	1		3	8				
		39	181	8-23-38	90	4.85	8.70	21		5		52	2		20	7				
				11-21-38	90	5.08	7.15	30		6		38	1		25	5	25.0	9.71	2.86	210
				2-11-39	90	4.96	10.00	28		13		41	2	1	15	5	37.5	9.42	2.86	162
				12- 4-40	105	5.15	5.8	32		5		63			3	6		10.16	2.69	230
III	F.	39	105	11-15-37	85	4.69	14.90	21	3	4		65	2		5	20				
		41	108	8- 6-38	85	4.51	10.60	20		5		63	1	1	10	16				
				11-15-38	80	4.58	11.15	23		8		35		5	29	18	27.9	10.20	3.57	200
				2-28-39	80	4.92	10.15	29		9		41	4		17	16	34.9	10.00	2.98	198
				11-25-40	88	4.52	6.60	36				62	2		7	14		10.38	3.28	177
IV	M.	43	165	11-13-37	90	4.61	13.45	10	3	8	1	54	1	1	22	19				
		45	158	3- 5-38	90	4.77	9.20	18		5		57	6		14	7				
				7-30-38	90	4.90	10.50	13		9		43	6		29	21				
				11-19-38	80	4.28	10.65	24		7		50	4		15	18	26.0	9.51	2.60	185
				2-25-39	80	4.78	10.50	27		4		28	2	1	38	15	37.5	9.48	3.02	186
				12-10-40	96	5.04	10.6	29				71			21	15		10.47	3.44	175
V	F.	34	120	11-15-37	90	4.58	7.20	26		3	3	63	1		4	13				
		36	123	3- 4-38	85	4.57	6.40	30			6	56	1		7	13				
				11-22-38	80	4.34	8.80	17		5		55		1	22	10	27.3	9.51	2.52	170
				2-28-39	85	4.40	8.10	27		9		33			31	7	29.8	9.50	2.69	220
				12- 5-40	88	4.59	8.00	24				76			10	8		9.69	2.56	203
VI	F.	38	171	11-11-37	85	4.38	15.40	29	1	5		55			10	20				
				3- 8-38	85	4.58	9.70	20		7		65			8	18				
				8-20-38	85	4.43	14.70	38		5		35	1		21	20				
				11-17-38	85	4.57	17.80	19		7		36			38	18	33	9.71	3.11	191
				2-27-39	90	5.58	15.80	29		12		53		1	5	14	31.6	9.90	2.60	190
VII	F.	54	148	11-16-37	90	4.92	10.85	24	1	7		60	2	3	3	13				
		57	154	3-11-38	85	4.58	7.80	21		6		64	2	2	15	22				
				8- 8-38	85	4.39	10.10	23		6		55	4		12	16				
				11-18-38	80	4.35	7.00	37		6		43	4		10	13	31.2	9.42	3.53	230
				2-10-39	90	4.64	7.60	26		8		40	5	1	20	13	33.3	9.81	3.61	226
				11-25-40	95	4.58	9.10	24				73	3		4	11		9.71	3.53	238
VIII	M.	38	176	11-13-37	85	4.66	6.70	29		11	1	46	4		9	16				
		40	182	8-22-38	90	4.66	8.70	28		6		50	4		12	15				
				11-16-38	90	4.62	9.35	23		5		57	1		14	12	34.8	9.80	3.11	245
				3-22-39	90	4.63	9.90	21		10		57	2		10	12	37.5	10.27	3.61	280
				12-12-40	100	5.03	10.60	32				67	1		16	10		9.60	3.40	317
IX	F.	57	106	11-15-37	75	4.38	8.40	31		2		60	1		6	32				
		59	92	3-22-38		3.04	4.80	40		10		43			7	32				
				8-30-38	90	4.69	11.30	30		12		50	2		6	30				
				12- 5-38	80	4.68	10.40	29		9		45	2		15	29	28.6	9.39	3.78	201
				3-13-39	90	4.68	8.90	24		7		46			23		28.3	10.51	3.70	180
				12- 3-40	94	4.72	13.9	31				66	3		11	31		9.64	3.70	202
X	F.	52	112	11-12-37	75	3.77	8.20	20		10		56	3		11	32				
		53	122	3- 2-38	85	4.44	8.60	10		6		77	1		6	28				
				8-15-38	75	3.87	7.35	15		2		30	3		50	31				
				11-17-38	80	4.18	12.75	16		4		53			27	35	30	10.59	3.28	260
				2-16-39	90	4.88	17.00	18		4		66	2		10	32	32.4	9.71	2.94	270
				11-30-40	88	4.30	9.50	17		3		80			8	29		10.53	3.32	274
XI	F.	55	95	11-13-37	85	4.59	11.70	29		7	1	54			9	10				
		57	94	3- 7-38	85	4.49	6.40	39	1	8		35			17	7.5				
				8- 5-38	85	4.67	10.00	33		11		46	3		7	10				
				11-19-38	80	4.16	6.80	36		8		51			5	8	31.5	11.27	3.40	220
				3-11-39	85	4.26	7.45	26		13		49	2		10	5	36.3	9.49	3.53	216
				12-21-40	90	4.58	6.05	40		1		56	3		7	4		10.00	3.28	260
XII	F.	28	95	11-15-37	65	3.40	6.10	44	2			47	2		5	35				
				3-13-38	60	3.55	6.95	32	3	7		45	3		10	34				
				8- 1-38	70	3.81	9.00	24		13		42	1		20	36				
XIII	F.	28	110	11-30-37	60	3.90	8.40	25	4	6		50	1		8					
				8-26-38	90	4.67	7.90	25		5		46	1		23					
				12- 5-40	80	4.52	8.60	42		1		57			6	27				
XIV	F.	42	115	11-30-37	65	4.25	9.20	16	2	3		66	1		12	28				
		46	154	3- 9-38	70	4.11	7.00	30		8		49	3		10	23				
				8-26-38	90	4.69	9.60	21		4		40	1		34	27				
				12-20-38	85	4.34	9.90	33		8		42	6		11	24	33.9	9.19	3.49	205
				3-16-39	80	4.29	11.2	29		9		47	1		14	23	39.3	9.08	3.65	198
				12-17-40	88	4.62	12.05	33				61	6		8	25		9.	2.69	203
XV	M.	44	146	11-20-37	90	5.02	11.00	28		6	1	60	1		4	10				
		46	154	8-26-38	90	4.50	8.80	41		1		37	4		17	5				
				11-15-38	90	4.69	6.70	41		2		32	3		22	7	32.8	9.61	3.11	160
				2-15-39	90	4.72	6.60	41		9		41	3	1	5	3	35.3	9.52	3.36	193
				12-12-40	103	5.19	6.85	46				54			15	5		9.60	2.88	226
XVI	F.	54	137	11-20-37	80	4.22	8.90	38		5		36	7		14	90				
		57	139	11-20-38	90	4.71	8.00	31		7		41	1		20	16	33.0	10.29	3.57	220
				3-12-39	85	4.63	11.70	11		14		50			25	26	30	9.08	2.77	178
				12-29-40	90	4.41	12.35	22				76	2		18	26		10.20	3.36	200

Chart I—Cellular and Chemical Constituents of Blood—Continued

Case No.	Sex	Age	Weight	Date of Exam.	Hemoglobin	Erythrocytes Millions per c.m.m.	Leucocytes Thousands per c.m.m.	DIFFERENTIAL WHITE CELL COUNT—(PER CENT)								Sedimentation Rate m.m. in 60 min.	Non-Protein Nitrogen	Calcium mg. per 100 c.c.	Phosphorus mg. per 100 c.c.	Cholesterol
								Small Lymphocytes	Large Lymphocytes	Large Mononuclear	Transitional	Neutrophiles	Eosinophiles	Basophiles	Non-Filament					
XVII	F.	44	146	11-20-37	90	5.48	9.70	19	3	1	.....	62	5	.....	10	16	.....	.....	.....	.....
				3- 5-38	80	4.26	11.30	25	.....	.....	.....	50	3	.....	22	5	.....	.....	.....	.....
				8-29-38	75	4.10	9.20	21	.....	5	.....	35	5	.....	34	19	.....	.....	.....	235
				12- 3-38	75	3.92	9.00	29	.....	6	.....	53	7	.....	5	12	38.2	12.02	2.94	260
				3- 9-39	85	4.45	11.90	20	.....	4	.....	64	1	.....	11	10	37.5	10.00	2.60	271
XVIII	M.	32	126	3- 9-36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27	.....	10.4	4.6	.....
			148	7-29-38	100	5.88	18.00	30	.....	8	.....	40	1	.....	21	.....	.....	.....	.....	.....
				12- 3-38	90	4.94	9.60	31	.....	7	.....	51	2	.....	9	21	40	10.00	3.19	210
				12- 7-40	100	5.28	11.15	52	.....	.....	.....	48	.....	.....	20	17	.....	10.47	3.99	162
																				230
XIX	F.	46	140	11-16-38	90	5.08	10.05	38	.....	6	.....	45	2	1	.....	5	35.2	9.22	3.61	160
				2-23-39	90	5.04	10.00	52	.....	3	.....	44	1	.....	.....	6	35.2	8.66	3.36	180
XX	F.	51	190	11-15-38	80	4.71	10.75	34	1	3	.....	37	2	.....	.....	14	33.3	10.10	3.49	200
				3-28-39	90	5.04	12.30	23	.....	1	.....	73	3	.....	.....	17	39.1	10.00	3.36	198
																				177
XXI	F.	66	165	11-15-38	85	4.53	9.20	32	.....	3	.....	41	6	.....	.....	25	29.4	11.96	2.94	210
				2-25-39	85	4.65	10.00	34	.....	5	.....	55	6	.....	.....	19	37.5	10.03	3.57	226
XXII	F.	54	165	11-25-38	80	4.44	12.80	32	.....	8	.....	57	3	.....	.....	13	38.0	9.51	3.36	170
				3-27-39	80	4.33	8.70	44	.....	8	.....	42	5	1	.....	9	33.3	9.10	3.23	220
				12- 6-40	90	4.67	9.75	46	.....	.....	.....	49	5	.....	5	13	.....	9.69	3.44	231
XXIII	M.	64	156	11-22-38	90	4.76	7.90	21	.....	5	.....	65	9	.....	.....	12	46.1	9.71	2.98	230
				2-21-39	90	4.59	6.60	27	.....	5	.....	63	4	1	.....	16	55.0	9.52	2.94	223
XXIV	F.	38	123	11-30-38	80	4.18	9.70	28	.....	8	.....	64	.....	.....	21	17	29	10.29	3.02	130
				3-18-39	70	3.86	9.00	30	.....	6	.....	63	1	.....	.....	18	34.3	10.40	3.61	140
				7-27-39	65	3.90	10.20	32	.....	1	.....	65	2	.....	11	16	34.1	9.07	3.11	116
				1-29-41	80	4.68	11.05	42	.....	.....	.....	57	1	.....	8	17	.....	9.81	2.56	145
XXV	F.	64	165	11-18-38	90	5.22	9.65	19	.....	10	.....	68	3	.....	.....	15	33.7	9.81	1.85	261
				2-24-39	85	4.45	8.40	25	.....	9	.....	62	3	1	.....	25	38.7	9.59	2.77	320
XXVI	M.	42	112	11-28-38	85	4.64	12.70	18	.....	6	.....	74	2	.....	.....	31	36.3	9.29	4.45	167
				2-17-39	85	4.49	14.00	17	.....	2	.....	81	.....	.....	.....	28	31.5	9.33	4.03	182
				12-13-40	95	4.68	14.50	14	.....	6	.....	78	1	1	3	21	.....	9.50	4.07	181
XXVII	F.	49	211	12- 6-38	90	4.83	10.45	27	.....	4	.....	68	.....	1	.....	10	36.6	9.49	2.60	230
				3-24-39	90	4.50	5.80	31	.....	6	.....	62	1	.....	.....	10	42.8	9.20	2.39	188

Laboratory Observations During Therapy

IN AN attempt to study the pathological changes in the cellular and chemical composition of the blood in cases of severe chronic arthritis, examinations of the bloods of 27 arthritic patients were made. As a check on the technique used, simultaneous blood studies were made on 20 normal individuals. These examinations were repeated during the period of treatment of the arthritic group in order to determine whether therapeutic doses influence the composition of the blood.

Chart I presents the results of these examinations in detail. Unfortunately not all of these patients returned for the present follow-up study, but sufficient examinations were made on each one to determine the primary existing pathological states of the blood and the effect of the therapy in correcting these.

The following information was obtained before, during and after therapy: differential blood counts, sedimentation rate, blood calcium, phosphorus, uric acid, total protein, non-protein nitrogen, sugar, Kline, cholesterol, and complete urinalysis. This is tabulated in Chart I. The information obtained by these periodic laboratory tests was of very little value in measuring the progress of the arthritis. No definite correlation could be found between any of the blood constituents and the nature, severity or progress of the disease. In practically all cases, however, the institution of Ertron therapy was followed by an improvement of the anemic state with a return to the normal level of the erythrocytes and hemoglobin. This, however, did not always parallel the clinical improvement of the patient.

ERYTHROCYTES AND HEMOGLOBIN: In practically all of the cases of rheumatoid arthritis there is a hypochromic anemia. This varies in degree as indicated on Chart II. The erythrocyte count is usually below normal, but the reduction in the red cells is not as great as the diminution of hemoglobin. During this therapy there is an increase in the number of red cells, and a more marked increase in the hemoglobin content.

In every case treated there was a very distinct rise in the hemoglobin content. This is shown graphically on Chart II. With one exception in which there was a very insignificant decrease in the number of erythrocytes, this form of treatment was followed by an increase in the number of erythrocytes. This is shown graphically in Chart III. The anemia which is usually present in untreated arthritic patients is corrected by this form of therapy.

The severity of the anemia was not as great in the group of patients which constitute this study as has been reported by other investigators. This is

probably due to the fact that our patients were private cases whose environment and nutrition was probably better than the average group of dispensary cases. The correction of this anemic state may be at least in part the cause of the improved general nutrition and sense of well being which follows this form of therapy.

The average percentage of hemoglobin before treatment was 79.7. After this therapy the average rose to 92.4. The average number of erythrocytes before this therapy was 4,260,000 per cubic mm. After such therapy the average rose to 4,740,000 per cubic mm.

LEUCOCYTES: In most of our cases the white blood cells were within normal limits. In the acute exacerbations or in the early acute stages of rheumatoid arthritis a leucocytosis of from 12,000 to 20,000 may occur. In the long-standing stages there usually occurs a leukopenia. There is a tendency toward an increase in the number of immature or non-filament cells. Details of the differential white cell count of each patient are given in Chart I. The average number of leucocytes before therapy was 10,370; after therapy the average was 9,470. In nine of the cases treated there was an increase in the number of white cells, and in nine there was a decrease.

SEDIMENTATION RATE: The sedimentation rate in each of these cases is listed in Chart I. In the active stages of rheumatoid arthritis the sedimentation rate may be very high and in some of these cases during therapy there is a diminution in the rate.

The sedimentation rate, however, is not a measure of the degree of clinical improvement, for in many cases where the clinical improvement was marked and sustained the sedimentation rate remained high. The average rate before Ertron therapy was 17.7 mm., in 60 minutes. After this therapy the average was 15.9. In 11 of the cases there was an increase and in 17 there was a decrease in the rate. Chart IV shows graphically the general trend of the sedimentation rates before and after treatment. It will be noted that the sedimentation rate after this form of therapy takes the same general course as the rates before treatment was instituted.

CALCIUM: Although in most of the cases of rheumatoid arthritis there is a general decalcification and osteo-porosis, the cause for this demineralization of the skeleton is not known. The serum calcium levels are usually within normal limits, although quite frequently there may be a definite elevation of blood calcium. Chart V graphically shows the values for the serum calcium before and after therapy.

Before therapy most of the values were within the normal range although some were 12 mg. per cent or thereabouts. After Ertron was administered there was a very marked stabilization of the calcium levels and in no case did it rise above 10.6. This

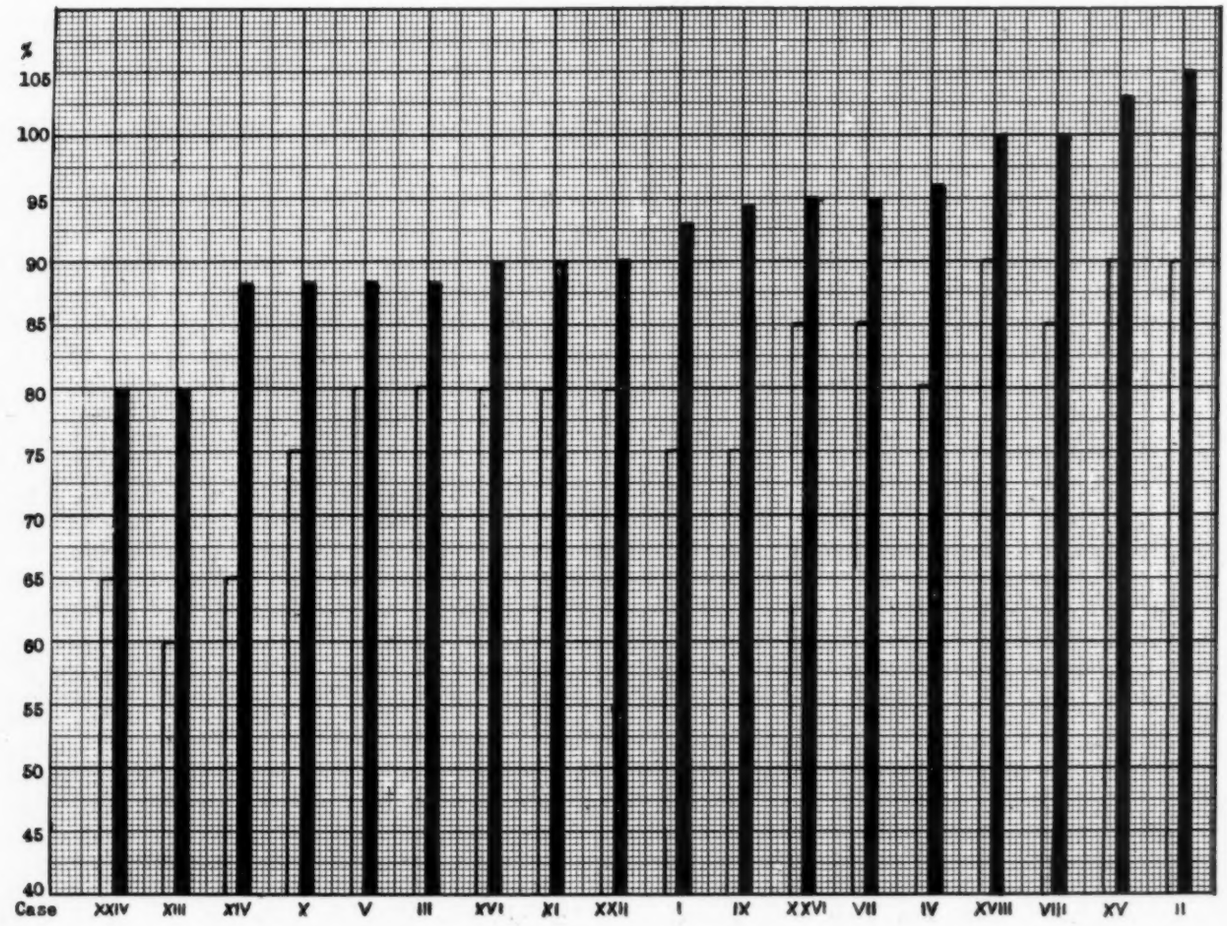

Chart II.
Hemoglobin content of blood or arthritic patients at beginning and end of therapy.
□ Before therapy ■ After therapy

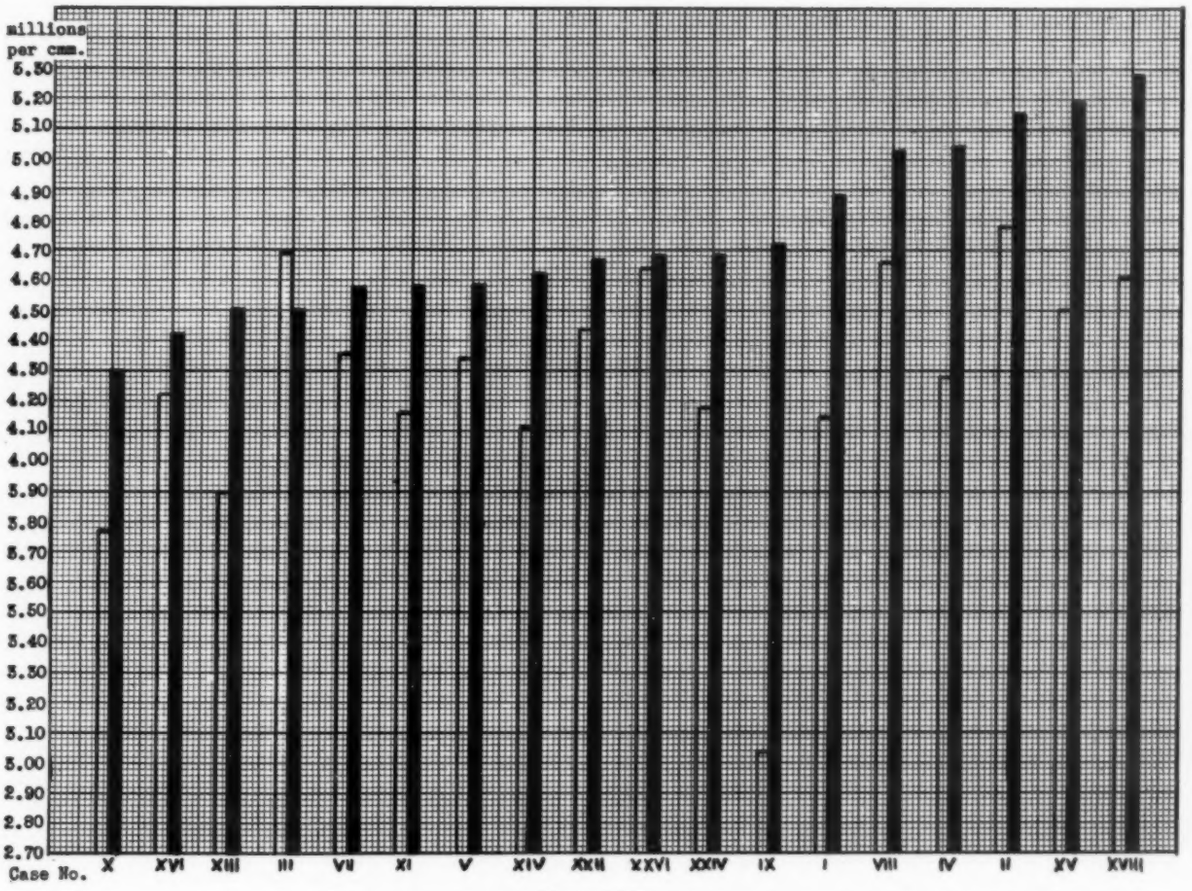

Chart III.
Number of erythrocytes per cubic millimeter of blood of arthritic patients at beginning and end of therapy.
□ Before therapy ■ After therapy

stabilization of calcium, as a result of this form of therapy has been discussed in detail by Reed.[2] The average before treatment was started was 9.96 mg. per cent. After treatment it was 9.75 per cent. In nine cases there was an increase, and in 15 cases there was a decrease in the blood calcium level following this type of therapy.

PHOSPHORUS: The average of the serum phosphorus before treatment was 3.23, after treatment it was 3.15. In nine of the cases there was an increase and in 16 a decrease in the amount of blood phosphorus.

NON-PROTEIN NITROGEN: The average before therapy was 32.8. After therapy it was 36.07. In 18 cases there was a rise and in six cases a fall in the non-protein nitrogen.

CHOLESTEROL: The average before Ertron therapy was instituted was 207.08 mg. per cent. After treatment it rose to 217 mg. per cent. In 16 cases there was an increase and in nine a decrease in the amount of cholesterol during therapy. Chart VII shows graphically the distributions of cholesterol levels of the blood before and after treatment. In some of the cases there was a very distinct rise while in others there was a very marked fall.

ROENTGENOGRAMS: The earliest pathological changes occur in the periarticular tissues, not in the cartilage and bone. One of the earliest changes to be noted in atrophic arthritis is effusion of fluid into the periarticular structures. Another early change is osteo-porosis. Frequently there is actual loss of bony substance at the joint margins producing irregular punched out areas. These are smaller than those which occur in gout. In rheumatoid arthritis the more common findings are a proliferation of the synovial membrane and a thickening of the capsule of the joint. An effusion into the joint is indicated by an increase in the soft tissue shadow and an interference with the normal position of the bones. Destruction of the cartilage is suggested by the narrowing of the joint space. Atrophy of the soft tissues above and below the joints usually occurs. Dislocation and ankylosis may occur in the later stages. In practically all of the cases there was a general decalcification involving most of the skeletal parts. Lipping and osteophytes also occur very frequently. In some cases there was marked alteration of functional activity without any roentgenographical findings.

Roentgenograms were taken at frequent intervals during the course of treatment. These serial films demonstrated that the roentgenographic findings cannot be used as a measure of the clinical progress of any specific case. In some there was a return of normal function with no demonstrable alteration in the roentgenographic pathologic picture while in others the return of normal activity took place in the presence of an increasing decalcification. The roentgenograms only very rarely showed recalcification of the bone or repair of the skeletal parts. One of the consistent findings, however, was the marked diminution in soft tissue swelling.

CLINICAL OBSERVATIONS: The data obtained in the history, physical examination, special examinations, and orthopedic examinations, are given in detail in Chart VI. The observations made in the course of treatment showed that beneficial results are sometimes obtained as early as three to six weeks after the administration of Ertron. In many cases, however, there were no demonstrable effects until after three months had elapsed.

The earliest sign of improvement in these arthritic patients was a general improved sense of well-being and improvement in the general metabolic activities of the body as a whole. There then occurred increased muscle tone, less stiffness, diminution of pain, increased mobility, decreased swelling, lessened deformity, less tendency to become fatigued, and a gradual return to normal functional activity. There was also a marked improvement in the nutritional state of the skin and epidermal appendages such as the hair and nails.

These arthritic patients were treated with Ertron and food management, and were observed by us for varying periods of time ranging from six months to five years. Since these were all private patients, it was not always possible to obtain all the information desired. The cost of carrying out the various laboratory examinations was in many cases beyond the means of the patients. Unfortunately, in these early periods, many cases were studied only clinically and hence no comparison can be made of their x-ray or blood changes at this time. A record of their clinical progress was made in every case, however, and a clinical report of these patients will be published in the future.

Since a complete history and record of the clinical findings of each case is summarized in Chart VI, it seems unnecessary to repeat the data. It will be noted that very definite improvement in the clinical condition occurred in a large majority of the patients during Ertron administration. It will further be noted that this improvement was progressive and when therapy was continued this improvement was complete and sustained.

In the evaluation of any form of therapy three factors are important:

1. The safety with which the therapeutic agent may be effectively administered.
2. The beneficial effects of the agent used, i.e., the alteration of the course of the disease.
3. The duration of the beneficial effects after the treatment is stopped, i. e., the permanency of the improvement.

SAFETY OF THE THERAPEUTIC AGENT: With proper food management symptoms of intolerance to even large therapeutic doses of Ertron usually do not occur. In a few hypersensitive individuals, or in some patients who do not receive an optimum diet, symptoms of intolerance may follow the administration of the massive doses used in arthritis therapy. These are slight nausea, heartburn, and anorexia. These

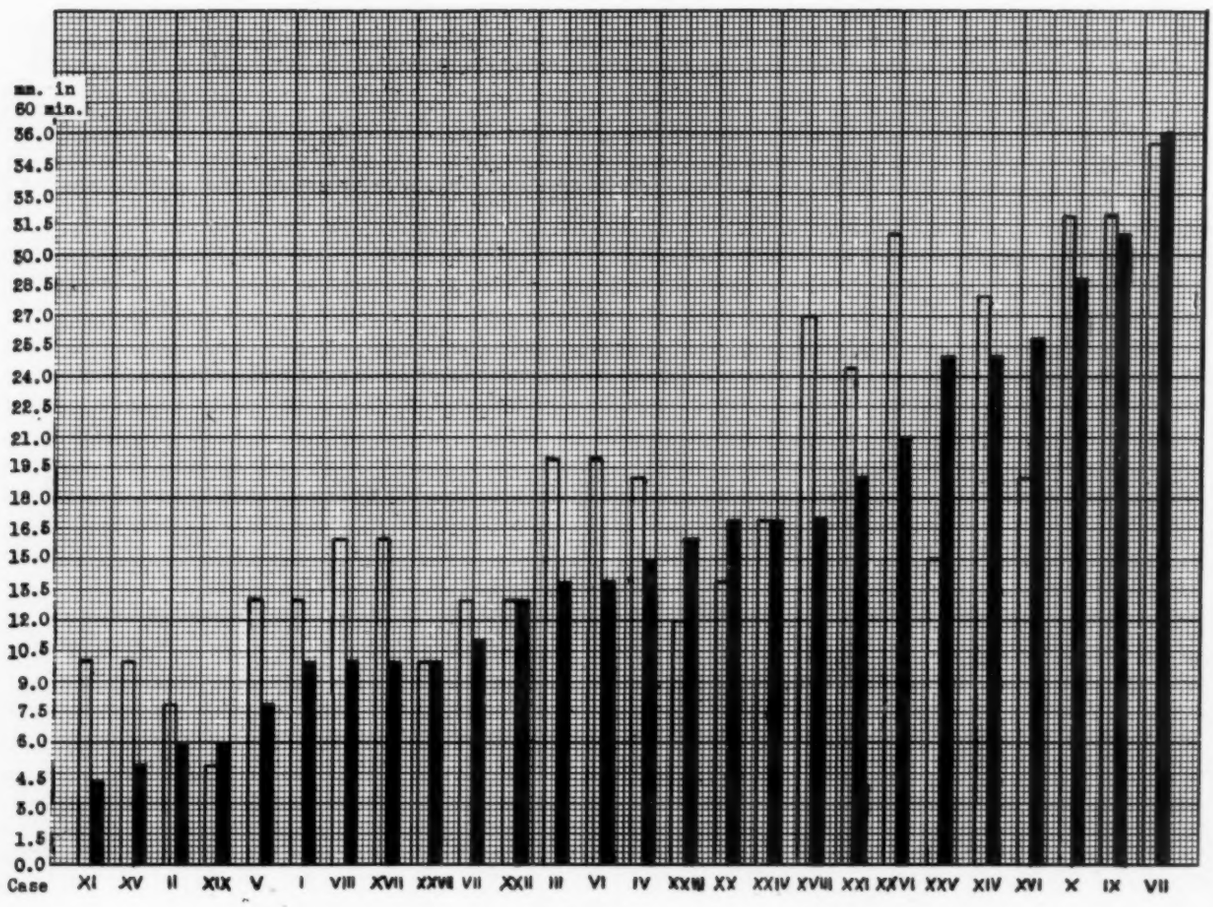

Chart IV.
Sedimentation rate in arthritic patients at beginning and end of therapy.
□ Before therapy ■ After therapy

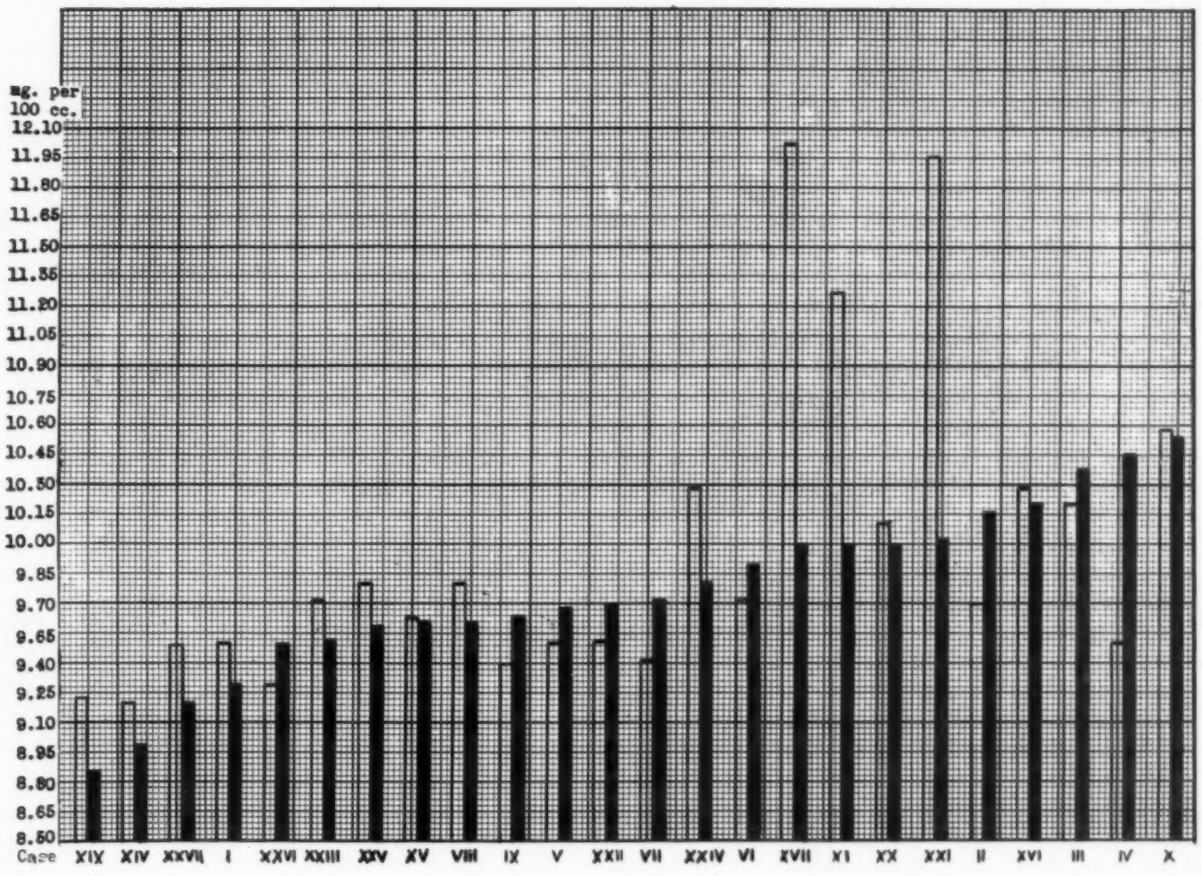

Chart V.
Serum calcium of arthritic patients at beginning and end of therapy.
□ **Before therapy** ■ **After therapy**

mild digestive disturbances disappear almost immediately after the cessation of Ertron administration and usually do not recur when this therapy is again instituted. These symptoms are often due to dietary indiscretions and are frequently the result of disturbed liver function.

Many of the conclusions regarding toxicity of vitamin D are based on experiments or clinical trials in which ultraviolet-irradiated forms of vitamin D rather than Ertron were being studied. Severe toxic symptoms such as pronounced anorexia, nausea, vomiting, diarrhea, nocturia and polyuria were encountered by other investigators when these other forms of vitamin D were used. These symptoms of toxicity have never occurred in any of our patients who received Ertron.

Summary

A FIVE-YEAR follow-up study was conducted to determine the efficacy of Ertron therapy in the treatment of chronic arthritis. During this period more than 300 cases were studied. Eighteen of these were sufficiently cooperative to permit repeated examinations, both clinical and laboratory, over a sufficiently long period. In order to eliminate the possibility of spontaneous remissions only those patients who had had arthritis more than two years and who had proved resistant to all of the older forms of therapy were accepted for this study. In this group of patients the average duration of the arthritic process was 10 years, the minimum duration was three years and the maximum duration was 22 years. Extensive blood studies were made, but no correlation could be found between the clinical improvement of the patients and the alteration in the levels of any of the constituents, either cellular or chemical. One of the consistent findings was an increase in the hemoglobin level and the number of erythrocytes during this therapy.

Serial roentgenograms were made of each patient. In most of the patients there was a general decalcification involving not only the arthritic joints, but also the apparently normal skeletal parts. In spite of the careful scrutiny no correlation could be detected between the clinical improvement of the patients and changes in the roentgenograms during therapy. Since in some there was a return of normal function without any alteration in the radiological picture, and in others there was a return of normal activity in the presence of an increasing decalcification while in still others disappearance of symptoms was accompanied by a redeposition of calcium in the bones, it is demonstrated that roentgenographic findings cannot be used as a measure of the clinical progress of any specific case.

During this study it became apparent that in order to obtain the maximum effect of any therapy it was essential to consider each arthritic patient as a separate and distinct problem. The patient had to be treated as a total person in order to combat the general systemic effects of arthritis. This necessitated furnishing an optimum diet, prescribing rest

Chart VI—Clinical Data

Case No.	Sex	Age	CHARACTERIZATION OF ARTHRITIS				PREVIOUS THERAPY		Course Before Ertron Therapy
			Duration	Type	Extent of Involvement	Activity of Disease	Forms	Degree of Improvement	
I H4610	F	72	9 Yrs.	Atrophic arthritis with osteoporosis	Left acetabulum, head of femur, left sacroiliac joint, shoulders, hands	Shoulders, hands slowly progressive—a progressive osteoporosis, cystic in areas	Hyperpyrexia, salicylates, aspirin	None	Gradually progressive—non-responsive, resisting treatment
II H4585	M	39	7 Yrs.	Atrophic; mixed type with some hypertrophic changes	Hands, knees, ankles, back	Very active	Vaccines, salicylates, aspirin, diathermy	None	Increasing pain and disability; joints progressively involved; insomnia
III H4498	F	41	9 Yrs.	Atrophic	All joints of body including neck, sacroiliac joints	Very active	Vaccines, teeth extracted, tonsillectomy, aspirin, salicylates, sulphur baths, diathermy, massage	None	Rapidly progressive, entire body involved, helpless, bedridden, pain pronounced
IV H4626	M	45	7 Yrs.	Rheumatic fever—polyarthritis, atrophic	Entire body	Very active	Salicylates, diathermy, ultraviolet rays, infra-red, hydrotherapy, hospitalization, spa therapy, tonsillectomy	None	Rapidly progressive, all joints involved, practically helpless, pain severe
V H4597	F	36	6 Yrs.	Atrophic	Neck, shoulders, back, including sacroiliac	Moderately progressive	Ovarian extracts, hospitalization, baths, vitamin B, diathermy, fever therapy, sedatives	None	Progressive, gradual loss of ability to do daily tasks, pain, sleeplessness
VII H4497	F	56	9 Yrs.	Atrophic	Neck, shoulders, arms, wrists, hands, sacroiliac, hips, knees, ankles—helpless	Very active, rapid progression	Hysterectomy, tonsillectomy, special diets, salicylates, heat treatments	None	Gradually became helpless—lost 47 lbs. May-Nov., 1936
VIII H4671	M	40	3 Yrs.	Atrophic, mixed type	Right ankle, right knee, right shoulder	Very severe, bedridden	Heat, salicylates, aspirin	None	Progressively worse
IX H4563	F	59	10 Yrs.	Atrophic with hypertrophic changes	General—all fingers, right and left wrists, knees, elbows, shoulders, ankles, neck	Slowly progressive	Electrotherapy and massage, diathermy, vaccines, 5 physicians previously, sedatives, heat	None	Progressively worse—bedridden 2 yrs. prior to 1936, pain very severe, helpless and hopeless
X H4542	F	53	16 Yrs.	Atrophic	Entire body involved—arms, wrists, hands, shoulders, neck, hips, knees, ankles, feet, spine	Slowly progressive	Salicylates, aspirin, hydrotherapy, intravenous injections, colonic irrigation, massage, casts, weights, electrotherapy, diathermy, sedatives, diets	None	Progressive—elbows flexed, knees flexed and rigid at about 45° angle, partial luxation both knees, wrists and hands, rigid shoulders, very painful, state of complete helplessness
XI H4755	F	57	15 Yrs.	Atrophic	Spread from joints of little fingers to shoulders, knees, ankles, elbows	Slowly progressing	Heat, hyperpyrexia, salicylates, aspirin, rest	None	Gradual and persistent with slight deformity
XIV H4721	F	46	22 Yrs.	Atrophic	Neck, shoulders, elbows, wrists, hands, sacroiliac, hips, knees, ankles, feet; muscular atrophy	Progressive to ankylosis	Hospitalized 11 times, salicylates, 60 vaccine injections, Bucks extension, diathermy, joint surgery refused	None	Progressive to ankylosis; confined to bed most of time
XV H4672	M	46	14 Yrs.	Atrophic: Marie-Strumpell	Sacroiliac, lower spine, left hip	Gradual increase in severity	Hospitalized, attended large clinic, heat treatments, salicylates, back taped	None	Gradually becoming worse
XVI H4828	F	57	14 Yrs.	Atrophic	Elbows, neck, shoulders, ankles, knees, sacroiliac	Gradual increase in severity	Vaccines for 2 yrs., salicylates, sedatives	None	Very slowly involving many joints of body
SS10 GROUP XXII H4606	F	56	7 Yrs.	Atrophic	Big toes, left foot, knees, shoulders	Slowly progressing, mild dizziness	Heat, salicylates, aspirin, intravenous injections twice weekly for 3 yrs.	None	Continuously progressive with occasional exacerbations; weakness
XXIV H5146	F	40	10 Yrs.	Atrophic with hypertrophic changes	Both wrists, elbows, hands, knees, ankles, jaw	Progressive ankylosis; wrists, elbows	Salicylates, aspirin, vaccines, heat, diathermy, drugs		
XXVI H4681	M	43	5 Yrs.	Atrophic	Shoulders, elbows, wrists, hands, knees, ankles, feet	Severe pain; all joints stiff and sensitive; wrists, hands, knees enlarged; nodular deformities; unable to work	Cinchophen, heat treatments	None	
XXVIII	M	33	8 Yrs.	Atrophic: Marie-Strumpell	Neck, dorsal and lumbar spine, sacroiliac, hips	Could not move head or stand erect; shuffled feet, unable to raise them; body inclined to left; body brace; had to flex knees to look up	1½ yrs. ultraviolet, 10 diathermy treatments, slept on Bradford frame, aspirin, codeine, Clayton brace, fever therapy, sulphur	None	Progressively worse; pain severe at all times, ankylosis apparently progressing, rapidly increasing disability

Chart VI—Clinical Data—Continued

OBSERVATIONS DURING COURSE OF ERTRON THERAPY					PERIOD SINCE LAST TREATED WITH ERTRON			REMARKS
Duration of Ertron Therapy	Daily Dose 7.5 Gr. Caps.	Toxic Manifestations	Changes Observed	Degree of Improvement	Duration	Condition	Medication	
1 year, then at intervals	3- 6 Caps.	Occasional slight dizziness	Increased sense of well-being, diminution of pain and swelling	Fair	2 Yrs.	Good except for left hip	Occasional Ertron	Patient's left hip is same; osteoporosis and arthritic process arrested; should continue rigid treatment; shoulders and hands functionally recovered
15 Mos.	3- 5 Caps.	None	(After 3 mos.) pain, swelling, stiffness much improved; (after 6 mos.) pain, stiffness entirely relieved; (after 1 yr.) no physical, objective or subjective symptoms; (after 15 mos.) appetite, weight, general condition normal	Excellent	2 Yrs.	Normal health and functional ability	None	Apparently completely recovered; a police officer—now working full time any weather; completely recovered
2 Yrs.	3- 8 Caps.	None—occasional headache	(1 mo.) pain began to subside; (3 mos.) pain negligible; (6 mos.) increased mobility, able to care for self; (1 yr.) joints resume normal appearance and motion; (2 yrs.) completely confident and competent	Excellent	1 Yr. 5 Mos.	Normal health	None	Normal routine—enjoying life
Since July, '36	3-12 Caps.	Increased urinary frequency—ceased in about 5 days	(3 mos.) pain markedly less; increased mobility and much stronger in 6 mos.; (1 yr.) able to care for self entirely; (2 and 3 yrs.) teaching and in full activity; (4 yrs.) hands slightly improved	Excellent	Under treatment	Disappearance of all symptoms; fully competent	None—still under treatment	Teaching full time; general good health; hands slowly returning toward normal
1 Yr.	3- 4 Caps.	None	Disappearance of pain and insomnia in 3 mos.; fully competent and working in 1 yr.	Good	1 Yr. 4 Mos.	Fully competent and working	None	Patient was thin and completely discouraged—morale fine in 3 months; breast amputation performed in 1937 shows no postoperative symptoms; working; good strength
2 Yrs. 6 Mos.	3- 7 Caps.	None	Increased sense of well-being, more courage, maintenance of weight; after 6 mos., increased functional activity and diminution of pain, able to get about; (1 yr.) moving freely without pain; (2½ yrs.) apparently recovered	Excellent	2 Yrs.	Entirely competent; again teaching piano	None	Patient has regained lost weight—now 154 lbs. complete functional activity; very busy every day at her work
8 Mos.	3- 4 Caps.	None	Pain and disability disappeared in 3 mos.; is now well	Excellent	1 Yr. 6 Mos.	Recovered—disappearance of all symptoms	None	Working daily; managing large office
4 Yrs.	3- 4 Caps.	Nausea during first two weeks of Ertron therapy only	(3 mos.) slept without use of hypnotics; increased sense of well-being; diminution of pain; at present can walk, do housework, knit, crochet; again interested and smiling; gradual ability to comb hair, etc.	Fair	Under treatment	Waits on self entirely; cheerful and much stronger; courage regained	None	Patient has changed from state of complete helplessness so that at present she is able to do many things around house: cooks, sews, knits, crochets
4 Yrs. 7 Mos.	3- 8 Caps.	Nausea first month; increased urination; slight headaches at first—none since	(3 mos.) improved appetite, disappearance of insomnia, diminution of pain, better nutrition of skin, increased mobility, could comb hair; (1 yr.) increased mobility of all joints; (2 yrs.) absence of pain, further increased mobility; (4 yrs.) does housework, types, luxation of knees gone, are fully movable	Good	Under treatment	Seems to have lost will to walk although there is return of mobility and strength	None	Patient has recovered her strength and functional activity but requires physical re-education to enable her to walk again
3 Yrs.	3- 4 Caps.	None	Improvement has been slow; disappearance of pain first 5 mos.; disability entirely gone; doesn't fatigue as easily	Fair	1 Yr.	Fairly good; able to work full time	None	This patient has a pronounced chronic gastroptosis which may be a factor in etiology
2 Yrs.	3-10 Caps.	Nausea first 5 weeks only	Improved sense of well-being; pain much less in 3 mos.; could move some in bed in 6 mos.; by 2 yrs. around in wheel chair; progress of disease seems to be arrested	Fair	2 Yrs.	Able to joke about condition; much relief; changed from bed to wheel chair; moves about, pain gone	None	Patient now has a fairly happy disposition and is much interested in others around her; believe further management and treatment will show more progress
10 Mos.	3- 8 Caps.	None	Arthritic process arrested, diminished pain, increased mobility	Good	1 Yr. 6 Mos.	Working every day, does some lifting, entirely competent, condition good	None (Taylor Back Braces)	Return to normal business routine; now very active, moving around freely
9 Mos.	3- 6 Caps.	None	Gradual lessening of pain and stiffness; all enlarged joints are now normal in appearance; skin is clear and normal in appearance; no fatigue; able to stand all day at work	Excellent	1 Yr. 8 Mos.	Excellent; working every day; disappearance of all pain and stiffness; return to normal mobility	None	Patient has slight pain after hard day at work; believe more treatment desirable
4 Mos.	3- 4 Caps.	None except occasional nausea	Disappearance of pain, swelling and deformity; return of normal function; no dizziness; gained weight, 147-162 lbs.	Good	2 Yrs.	Health excellent; occasional pain when fatigued; performs all home duties	None except occasional aspirin	Still subject to fatigue, but not so pronounced
2 Yrs. 4 Mos.	3- 4 Caps.	None	Improved sense of well-being; markedly diminished pain and swelling; movement of joints restored to large degree; general health much improved	Good	Under treatment now	Continuous improvement; plays piano; manages house without undue fatigue	None	Patient shows steady improvement
2 Yrs.	3- 4 Caps.	Voided more frequently for 2 months	(3 mos.) disappearance of pain and swelling; increased mobility of joints; deformity gradually disappeared in 1 year except knees, which are still slightly enlarged	Good	Under treatment now	Continuing improvement; working full time; no undue fatigue	None	In spite of very unfavorable environment, patient continues to improve
4 Yrs.	3-10 Caps.	Nausea at height of dosage	Motion in neck recovered; can move head A., P., and lateral; pain subsided; motion in hips increased many degrees; can bend forward and touch ankles; taut feeling gone; can now row boat, swim, play volley ball; can play tennis 2 hrs. without distress	Good	Under treatment now	Health improved; actually sturdy; works full time and is enjoying life	None	Patient continues to improve

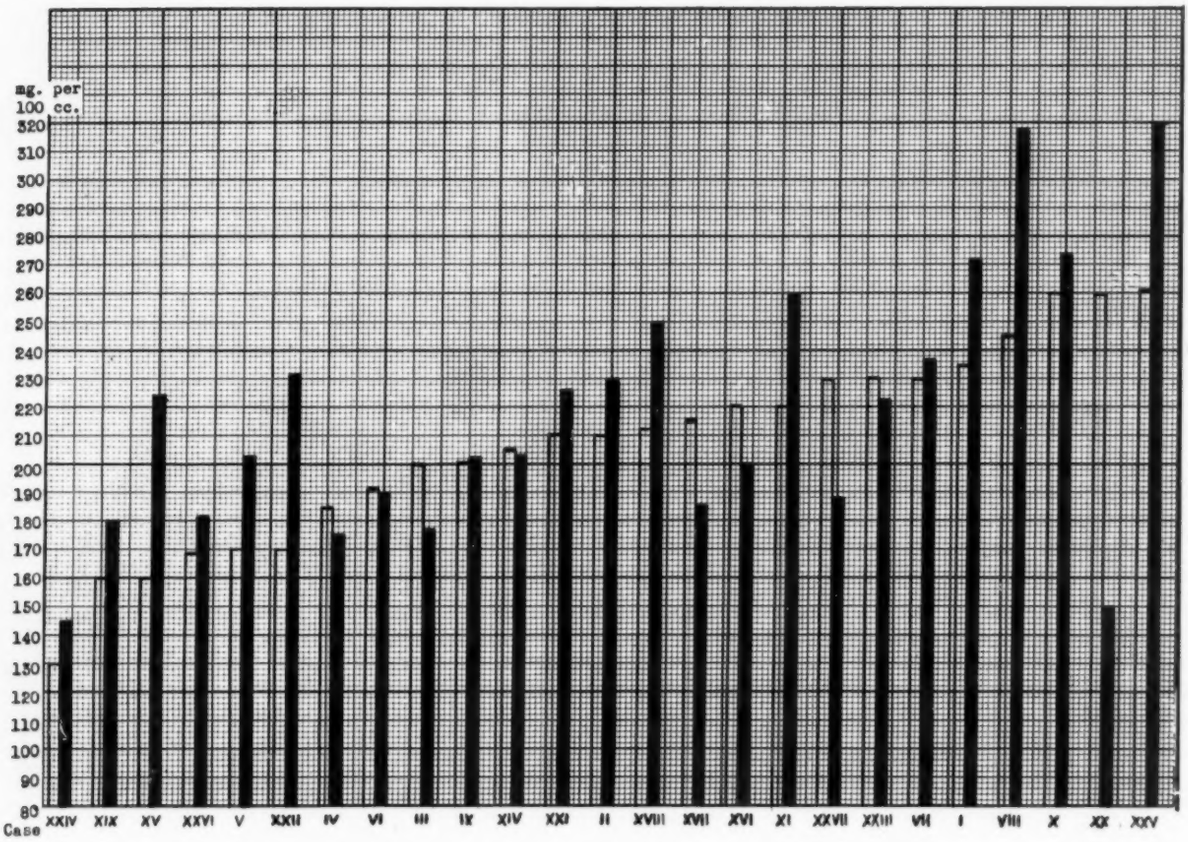

Chart VII.
Cholesterol content of blood of arthritic patients at beginning and end of therapy.
□ Before therapy ■ After therapy

in some cases, exercise in others, to eliminate emotional strain by means of psychotherapy, and in general to bring the various physiological functions to a state of maximum efficiency.

It is, of course, advisable to eliminate all possible etiological factors. In this study, however, in order to specifically test the efficacy of Ertron no attempt was made to remove foci of infection, or surgically treat any other existing pathology. It was only after the effects of this medical management and psychotherapy were determined that Ertron was administered. The value of this remedial agent in the treatment of chronic arthritis was definitely demonstrated.

Conclusions

COMPLETE laboratory examinations of the blood and urine demonstrated the fact that no correlation exists between functional improvement and changes in any of the blood constituents.

2. Although the roentgenographical findings were a measure of the degree of existing pathology, there was no correlation between the radiological changes and the degree of functional improvement.

3. In all cases treated with Ertron, there occurred a definite rise in the number of erythrocytes up to the normal level. The hemoglobin level followed, in general, the course of the erythrocytes.

4. In a large majority of these cases, there occurred improved functional activity, increased strength, and a general sense of well-being.

5. This study indicates that when Ertron is administered in adequate dosage and for a sufficiently long time the beneficial effects are sustained and may be permanent even after therapy is stopped.

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Plasma Protein

—Its Physiological Action and Therapeutic Application—

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THE spectacular benefits resulting from blood plasma administration in so many disorders[1, 2, 3, 4] have awakened a new and greater interest in the physiology of the plasma

proteins. An intelligent conception of the physiology of these proteins is essential for an adequate understanding of all phases and types of shock. The possession of this knowledge is equally necessary for one to administer effectively human plasma in the treatment of the many disorders in which it has proved to be a specific. It is therefore fitting and proper that this phase of physiology should be given a more general and detailed consideration than it has received heretofore.

The plasma proteins are intimately involved in the maintenance of the proper blood volume, the circulation of the cellular elements of the blood, clot formation, immune body production and many other important physiological functions.[5] It is the intention of the author, however, to limit the scope of this paper to the part that these proteins play in the maintenance of the proper fluid balance and the normal circulatory efficiency in the body.

In the process of gastro-intestinal digestion, the protein foods are split into the elemental substances, the amino-acids, and are absorbed as such in the lower portion of the small intestine.[6] These amino-acids are carried by the blood to the liver where some of them are utilized in the formation of the plasma proteins.[6] It is fairly well agreed that a large part of the fibrinogen, practically all of the albumin fraction, and at least a part of the globulin are produced by that organ.[7] Not only are these plasma proteins very largely manufactured there, but also a considerable quantity of the proteins thus formed are stored in the liver and held there as a reserve supply for the body to be used later as the need arises.[7] It is the opinion of Whipple and his co-workers that this protein is held in the liver cells as a part of the cell cytoplasm and not deposited as a specialized substance in the way in which glycogen is stored.[7] For the greater part, the tissue cells construct their own particular proteins from the amino-acids circulating in the blood stream subsequent to the digestion and the absorption of food.[6] Under certain circumstances, however, the body cells are capable of utilizing the plasma proteins for that purpose. This can be proved conclusively by the fact that an animal can be kept indefinitely in a state of complete nitrogen balance by the intravenous injections of blood plasma while it is being kept on a protein diet.[7]

The proteins are very complex substances and consist of molecules which are quite large, some of them having a molecular weight of as much as 35,000 to 192,000.[5] Because of the great size of its molecules it is practically impossible for such a substance to pass through a semipermeable membrane such as that comprising the capillary walls. It is thought, too, that the various plasma proteins are more or less loosely joined together, forming a fluid mass quite comparable to the cytoplasm of a cell body.[5] This, of course, makes it even less capable of passing through the vascular walls into the interstitial spaces.

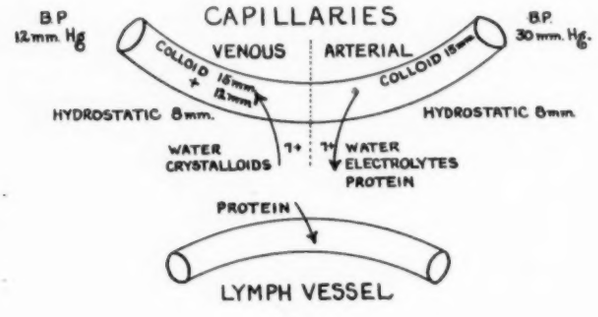
It should be remembered that the main purposes and the vital functions of the circulation are carried out in the capillary bed, the heart, arteries and veins being merely a propelling and conducting system for the blood cells and plasma. The capillary bed is very extensive, really so extensive that if all of these small vessels were functioning simultaneously, the capillaries alone could accommodate the entire blood volume.[8] Under normal circumstances the circulatory apparatus is so regulated that only certain portions of this very extensive capillary system are filled at any one time. A demand made by the tissue cells in the immediate vicinity of the capillaries in question determines their participation in the circulatory activity at a given time. During the ordinary course of events, as the need for more effective blood flow arises, the presence of metabolytes and the decreased oxygen tension[8] in the locality initiate the dilatation of the capillaries and thereby bring into play the various sections of the capillary bed necessary to meet the present need.

The ability of the capillaries to constrict or dilate in response to the demands of the tissue cells, regardless of the state of tone of the arterioles, has been definitely proved.[9] Under physiological conditions, the capillary walls are readily pervious to water, electrolytes and other crystalloids, but, as stated before, are not permeated to any extent by the plasma proteins.

Because of this almost complete lack of ability to permeate the capillary wall, the plasma proteins are quite effectively retained within the vascular lumen. Through its oncotic effect, its presence there assists in the proper distribution of water, the electrolytes and the other crystalloids and aids in the process of the interchange of these materials between the intra- and extra-vascular spaces and the cell bodies.[10] This interchange is brought about by two types of physical processes. Fig. 1 graphically illustrates the principles underlying these physiological phenomena.[5] In the arterial end of the capillary the blood pressure exceeds the sum of the intravascular colloid force and the interstitial pressure, giving rise to a positive filtration pressure equal to 7 mm. Hg. This pressure differential results in the passage of water with its dissolved substances from the intravascular into the extravascular spaces. The loss of fluid from the vessel lumen as the blood traverses the capillary to the venous end produces a decrease in blood pressure in the latter region to 12 mm. Hg. Coincidentally the concentration of the colloid, produced by the loss of fluid, causes the osmotic force to rise to 27 mm. Hg. The interstitial pressure remains unchanged, namely 8 mm. Hg. Thus there is produced a positive osmotic attraction equal to 7 mm. Hg. which satisfactorily effects the re-entry into the capillary of approximately the same quantity of fluid lost from the arterial side. In this manner the blood volume is maintained and the interchange of body fluids is accomplished.

In view of these facts, one may postulate, assuming a normal electrolyte balance and a full degree of cardiac compensation, that the presence of a normal concentration of plasma protein in the intravascular spaces assures a normal blood volume and a satisfactory cardiac output. Under the

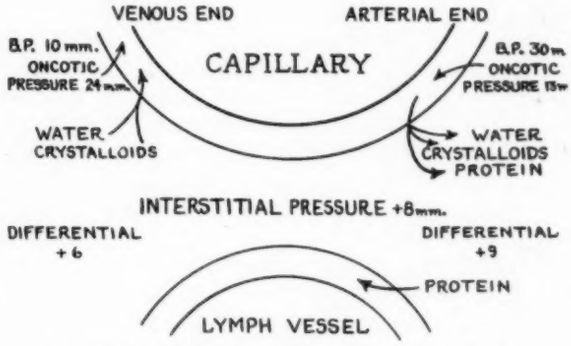
same circumstances the normal plasma protein concentration in the vessels provides a normal amount of extravascular fluid in the interstices and lymph spaces. It is obvious, on the other hand, that a decrease in the concentration of the plasma protein in the intravascular spaces from any cause



NORMAL FLUID BALANCE

Fig. 1.

devised. The theory advocated by Blalock[12] and that supported by Moon[12] deserve special consideration. Both of these investigators recognize clinical traumatic shock as being a circulatory deficiency, not cardiac or vasomotor in origin, characterized by a decrease in the volume of blood,



DISTURBED FILTRATION
WITH LOW PLASMA PROTEIN

Fig. 2.

will result in two deviations from the normal. Fig. 2 illustrates the disturbance of physiology which results from the hypo-proteinemic state. The greater differential between the blood pressure and the sum of the colloid force and the interstitial hydrostatic pressure results in the filtration of a larger quantity of water with its soluble substances into the extravascular spaces. At the other end of the capillary, because of the low plasma protein, the colloid pressure does not increase sufficiently to effect the re-entry of an equal quantity of this fluid. Thus there is produced the accumulation of an excess of interstitial fluid. Therewith a significant shift of the electrolytes into the extravascular spaces occurs.

Should the decrease in the total protein of the plasma occur rapidly as a result of an increased permeability of the capillary wall to all the constituents of the plasma, the occurrence of the phenomena just described would be considerably augmented. Such a situation, should it arise in the course of a few hours, would obviously result in several definite and recognizable effects. First, there must occur a decreased blood volume; second, there must follow a reduced cardiac output (volume flow of blood); third, there will develop a significant degree of hemoconcentration; and fourth, as a result of the aforementioned phenomena, there must follow circulatory failure, unless the disturbed physiology is corrected. These findings are identical with those observed in all cases of clinical traumatic shock.[11] It is only upon the basis of the rapid loss of large quantities of plasma from the capillaries, the walls of which have been made definitely more permeable to the plasma protein, that all the features of this type of shock can best be explained.

As a result of considerable investigation recently conducted, much light has been thrown upon this extremely important subject and a most effective means of combatting the disorder has been

reduced cardiac output (volume flow of blood) and hemoconcentration.

Blalock[12] contends that the trauma produces a profuse and widespread loss of whole blood and plasma elements locally into the injured parts. Thus the initial decrease in blood volume is produced. Subsequent to this, cardiac output is decreased, arteriolar constriction occurs, the blood pressure is diminished, capillary stasis develops and cell anoxia is produced, followed by the elaboration of toxic substances. As a result of this toxic substance the capillaries throughout the body are dilated and their walls made permeable to all the elements of the blood plasma. As this process progresses the blood volume is further decreased, capillary stasis is augmented, circulatory failure develops and the death of the patient supervenes.

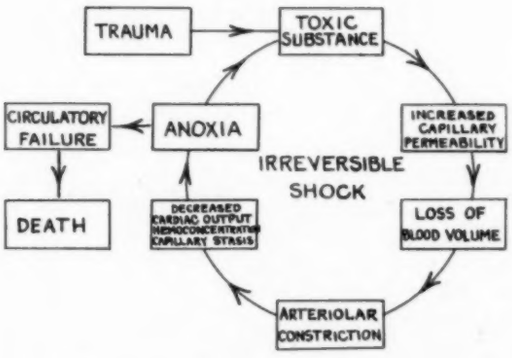
In accordance with the theory of Moon,[13] it is assumed that, at the site of and as a result of the injury, there is produced a toxic substance which is capable of producing and does bring about a widespread and general dilatation of the capillaries and an increased permeability of their walls, not only to the other constituents of the plasma, but to the plasma protein as well. The degree of the capillary dilatation and increased permeability is approximately proportionate to the amount of the toxic substance liberated.

With these facts in mind, the mechanism underlying traumatic shock readily can be comprehended. The injury to the tissue cells brings about the production of effective quantities of the toxic substance. This factor acts upon the capillaries locally at the site of trauma, and generally throughout the body, bringing about their dilatation and an increase in their permeability to all the constituents of the blood plasma. With the profuse transudation and exudation of water, electrolytes and plasma proteins, the blood volume is materially decreased and hemoconcentration occurs.

The hemoconcentration, the increased viscosity

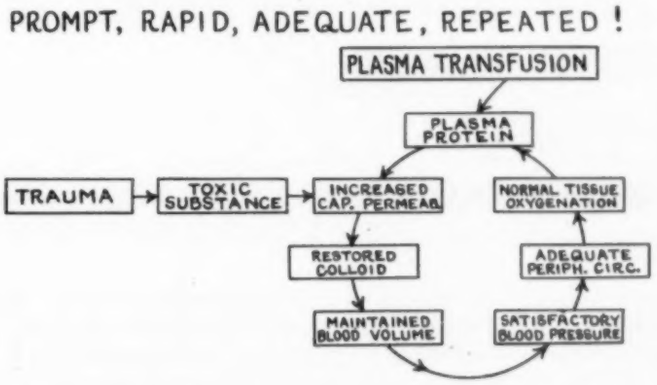
of the blood, the decreased blood pressure, and the circulatory stasis as it occurs in the dilated capillaries result in cell anoxia. It has been proved that tissue anoxia itself is capable of and does initiate the production of the toxic substance.[8] Thus, there is added a second factor which contributes to the greater dilatation of the capillaries and a more widespread and profuse loss of the intravascular fluid resulting in the further decrease in the blood volume and a more marked hemoconcentration. In this way a vicious circle is instituted with the establishment of irreversible shock. Eventually the peripheral arteriolar constriction fails to compensate for the increasing loss of blood volume, the vital centers suffer from anoxia, the circulation fails completely and death follows.

A review of the facts stated above should convince one that the physiologic approach to the treatment of shock is not by the transfusion of whole blood, because hemoconcentration already exists. The introduction of whole blood, to say the least, will not most effectively overcome this condition and will not contribute the maximum toward the relief of capillary stasis. The early administration of sufficient plasma, however, will replace



THE MECHANISM OF SHOCK WITH ITS IRREVERSIBLE PHASE

Fig. 3.



THE PREVENTION AND CURE OF TRAUMATIC SHOCK

Fig. 4.

lost plasma protein, restore fluid balance, increase the blood volume and the cardiac output (volume flow of blood), relieve tissue anoxia and prevent circulatory failure. Therapy inadequately administered or treatment begun after irreversible shock has developed is almost certain to be of no avail.

Hemorrhage

IN THE shock occurring as a result of hemorrhage a somewhat comparable situation obtains. While it is true that this type differs in some features from the usual clinical traumatic shock, the difference lies primarily in the mode of production of the initial loss of blood volume. As the blood loss takes place the peripheral arteriolar constriction occurs in the attempt to compensate for the decrease in the blood volume. Should the hemorrhage not be too severe,[5] the situation is thus taken care of and recovery is quite possible without specific treatment. However, if the hemorrhage should be massive, the constriction of the arterioles does not fully compensate for the blood loss, the peripheral circulation becomes inadequate, and tissue anoxia must occur. In proportion to the degree of anoxemia, there will develop the production of the toxic substance. As previously described, there occurs generally throughout the body, as a result of this toxic substance, a dilatation and an increased permeability of the capillaries with the profuse and widespread loss of plasma protein and other plasma constituents. Here, likewise, the loss of the plasma adds to the decrease in the blood volume, thereby increasing the capillary stasis and tissue anoxia. A most important point is the fact that, although the actual hemorrhage may have been stopped, the loss of blood volume continues as a result of the initiated shock factors; capillary stasis and tissue anoxia become more pronounced; and eventually the death of the patient occurs.

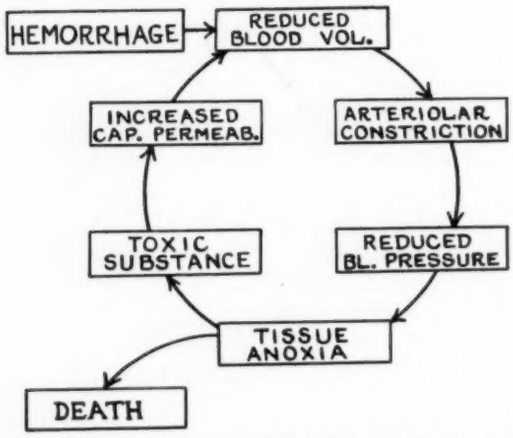
There can be no doubt but that the physiological approach to the proper therapy of acute massive hemorrhage is the transfusion of a sufficient quantity of whole blood to replace approximately the amount of blood lost at the time of the hemorrhage. This statement, of course, presupposes the careful typing and the accurate cross-matching of the blood from the recipient and the several donors from whom the supply of blood for transfusion is to be obtained.

Although the precipitating cause of this type of shock is the loss of whole blood, we believe that the more important consideration, in most instances of hemorrhage, is the decrease in blood volume and not the loss of the red cells.[14]

As the basis for this statement, we have found, in our experience, that even in extreme shock from hemorrhage the transfusion of large amounts of plasma will restore consciousness, elevate the blood pressure, improve the pulse, check the sweating and relieve satisfactorily the desperate condition of the patient. This is not an unreasonable phenomenon when viewed in the light of the severely anemic patient who is up walking about with a red blood count of no more than a third to a fifth of

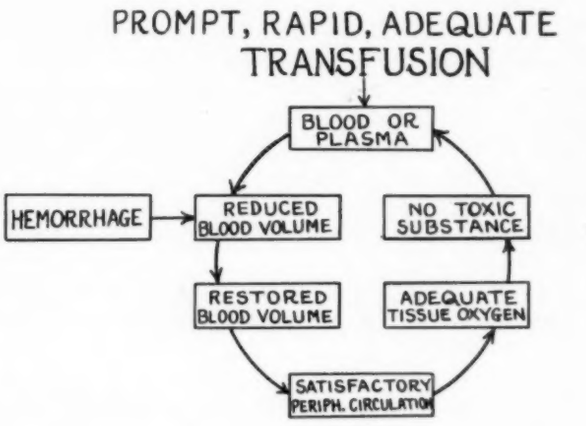
what it should be. The number of red cells present in those individuals is adequate to maintain life, even though the patient is not at bed rest. The two conditions under consideration are quite comparable.

After the blood volume has been restored by a transfusion of plasma, following hemorrhage, there exists an adequate quantity of the fluid element of the blood, but a marked decrease in the number of the red blood cells. One difference in the plasma-treated patient, however, is the fact that temporarily, at least, the red cells are of normal character and capable of complete functional activity. In most cases of severe anemia, on the other hand, the cells are of abnormal size, shape,



SHOCK FROM HEMORRHAGE

Fig. 5.



TREATMENT OF HEMORRHAGIC SHOCK

Fig. 6.

and hemoglobin content, and are, therefore, incapable of carrying on their normal functions. Another difference which may be used against one's paralleling the two conditions is the rapidity of the development of the anemic state following hemorrhage as compared to its slow inception in the anemia produced by other causes. In theory this may be a significant point, but in practice it apears to make no appreciable difference as regards the effectiveness of plasma transfusion.

In the uncomplicated case of acute hemorrhage the regeneration of the red blood cells occurs quite rapidly after the patient has been carried through the critical stage of his condition by the transfusion of blood plasma.

The second point which we wish to make in this connection is that, in our opinion, the results in the treatment of a large series of cases of massive hemorrhage will be better when plasma is used than when whole blood is employed. In making this statement we have in mind principally the small hospital, but really believe it will hold true in the larger ones as well. The basis for this opinion is primarily the amount of time that can be saved when plasma is employed over that which must be consumed in preparing for the transfusion of whole blood. To type and then cross-match consumes at least 30 to 40 minutes, the loss of which time can not be well afforded under the circumstances of an acute emergency. The fact is, one could easily save another 30 to 60 minutes by having a store of plasma on the ambulance which would make it available for immediate administration. Such prompt and efficient treatment would, no doubt, prove life-saving for at least the small number of the more critical cases which die en route to the hospital.

The final consideration is the fact that the serum is salvaged, so to speak, from the blood which has remained in the bank up to that time when its later use would be associated with danger. The plasma may be stored indefinitely and used with impunity at any time, provided the technic of its preparation has been carefully carried out.

Burns

IN THOSE cases of shock associated with burns there is an additional factor to be taken into consideration. The character of the shock is identical in all respects with the usual features of clinical traumatic shock.[15] The decreased blood volume, the diminished cardiac output, the hemoconcentration, and the subsequent circulatory failure all manifest themselves in the manner previously described. There is, in addition to the underlying pathology, however, a considerable loss of plasma protein as an exudate into the large bullae and from the raw skin surfaces after those lesions have become ruptured.[15] The quantity of fluid which is lost in the more extensive second degree burns is often enormous. This loss of serum added to the already considerably diminished blood volume may be the deciding factor in the development of the irreversible phase of the shock and may tip the balance between the life and death of the patient.

Just as in hemorrhage there is no doubt as to the preferable use of whole blood, so in the shock of severe burns there can be no question as to the specific indication for plasma administration. In these cases it is imperative that there be employed the immediate intravenous introduction of copious quantities of blood plasma in order to meet the physiological needs of the patient in the present

emergency.[16] The quantity necessary in some instances is extremely great, but nothing short of the required amount will be effective.

Hypoproteinemia

HYPOPROTEINEMIA is an extremely important consideration, both from the medical and surgical standpoints.[17, 18] In the whole of medical practice its prevention should be an aim in all treatment and its relief must be satisfactorily accomplished if the patient is to be given his rightful chance for recovery. In surgery, both preoperatively and after operation, it is a most significant consideration. In the diseases of and in operations upon the liver, the bile-ducts and the rest of the gastro-intestinal tract, it attains its maximal degree of importance.

In a consideration of the condition in its superficial aspect, we see that several disturbed physiological phenomena take place according to the physical laws operating in the body. The decreased concentration of the plasma protein within the blood vessels results in: first, a diminution of the osmotic force within them; second, a shift of the electrolytes and other crystalloids in the attempt to compensate for the decreased protein concentration there; and third, the accumulation of an increased amount of water in the extravascular spaces because of the lowered osmotic pressure in the venous end of the capillaries.

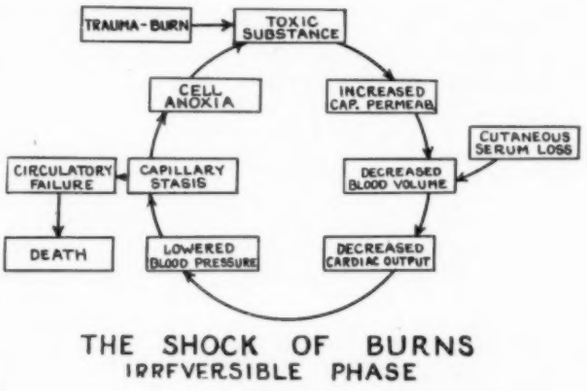


Fig. 7.

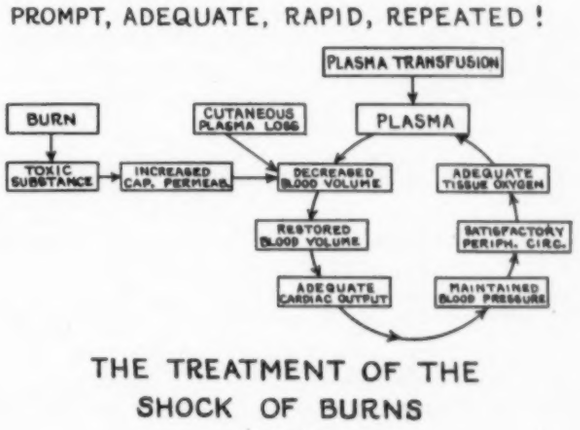


Fig. 8.

After the amount of the extravascular fluid increases sufficiently, the manifestations of clinical edema appear. While it is true that a considerable amount of the excessive extravascular fluid may accumulate before the presence of edema can be detected clinically, the important point is that, long before hypoproteinemia manifests itself, the body reserve of protein (extravascular fluid protein and hepatic stores) has been exhausted. This is an effort on the part of nature to conserve life by maintaining the plasma protein as near the normal level as possible, thereby preventing the development of the phenomena described above. The process is comparable to the body's maintenance of a normal blood sugar level in the early stages of starvation at the expense of the stores of glycogen in the muscles and liver.

More profound thought upon the subject reveals that there are deeper implications associated with the condition under discussion. One readily sees that in the presence of an appreciable degree of hypoproteinemia surgical or traumatic shock may be produced on much less provocation. Whipple[18] and his co-workers have proved conclusively that in conditions in which the hepatic stores of protein have been largely exhausted, such as occurs in hypoproteinemia, the animal's tolerance for anesthetics is greatly reduced. By carefully conducted experiments they have proved that in the presence of pronounced reduction of liver protein by starvation or by repeated plasma phoresis the lethal dose of chloroform is reduced to one tenth of that in the normal subject. The restoration of the plasma protein re-establishes the animal's tolerance for the drug.

In addition to these considerations one must remember that postoperatively, in the presence of an appreciable degree of hypoproteinemia, the fluid balance can not be so easily maintained.[19] It is obvious that with the administration of considerably less normal saline solution the patient may have water retention, diminished circulatory efficiency and such embarrassment to his vital functions that he succumbs because of these additional burdens.

The recognition of these rather important facts opens up a field of usefulness for plasma administration which has been more or less neglected heretofore. In any illness of such a nature that the oral intake of protein is prevented or is inadequate for more than a few days, the patient becomes a candidate for plasma transfusion.

In those instances in which the illness is of longer duration or is associated with the loss of moderate or greater amounts of serous fluid from the body, repeated transfusions of plasma are necessary to uphold the patient's reserve and guarantee him a fighting chance of recovery.

Every attempt should be made to prevent the exhaustion of the extravascular stores of protein. In health or in disease, so long as the digestive function is not disturbed, there is very little difficulty in maintaining a satisfactory protein intake. In those cases, however, in which the pa-

tients are sustained for days on glucose and normal saline, it must be remembered that, whereas the glycogen and electrolyte requirements are being met, the protein stores are becoming seriously depleted. In these cases, it is obvious that the transfusion of plasma and not whole blood is the indication which must be met. For one to wait until clinical evidence of edema develops, or until a noticeable decrease in the plasma protein reading occurs, before administering plasma may be compared to a surgeon's waiting for a mass to form in the lower right quadrant before operating for appendicitis.

The higher the fever has been, the greater the loss of serous and purulent discharge, and the poorer the patient's state of nutrition at the beginning of the illness, the earlier will plasma transfusion be required and the greater will be the quantity necessary to meet the needs of the particular patient.

The prophylaxis of the pathological reduction of the body proteins should occupy the same position in the minds of the profession as does the need of sufficient glucose, electrolytes, and vitamins.

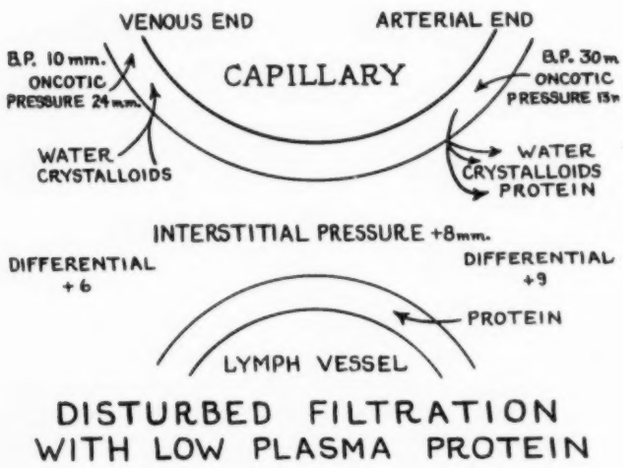


Fig. 9.

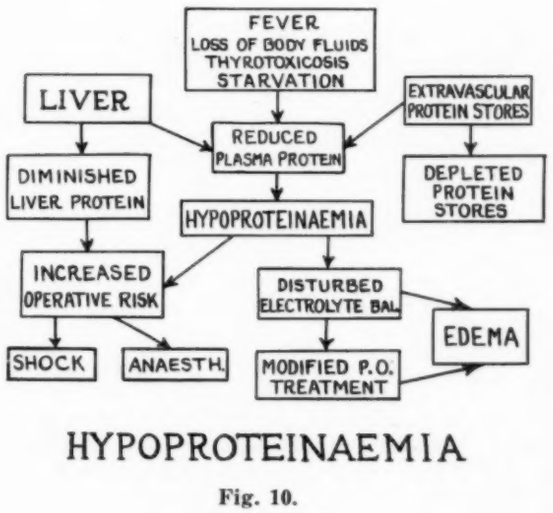


Fig. 10.

Summary

THE origin, formation, structure and storage of the circulating proteins are presented.

The physiology of the plasma proteins in respect to fluid balance and circulatory efficiency is discussed. The pathology underlying shock, the two more generally accepted theories of its production and the specific treatment of the disorder are considered briefly.

Hemorrhage and hemorrhagic shock are discussed. Their treatment with human plasma is recommended in preference to whole blood in an emergency, as any loss of time in typing and cross-matching can be avoided. This recommendation is based upon the satisfactory employment of plasma in quite severe shock with gratifying results. Whole blood is specifically indicated when and if such delay is not entailed and after the critical phase of the condition has been relieved.

Attention is called to the extreme importance of hypoproteinemia in both medical and surgical conditions. The prevention of its development, its significance in respect to anesthesia, liver disease, operative procedures and postoperative treatment are discussed. Suggestions as to its therapy are stated.

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Tentative Program

—November 5 and 6, 1941—

Morning Session—November 5—9:30 a.m.

SYMPOSIUM—THE TECHNICAL PROBLEMS OF INDUSTRIAL HEALTH:

Adequate health supervision in industry involves two great principles: the adjustment of the working environment to the employee; and the adjustment of the employee to the working environment—including also the human environment. The technical problems are the result of the applications of these first principles, and run the whole gamut of public health as applied to industry.

1. Health and Safety—Are They Inseparable?
2. The Nurses' Contribution.
3. Experiences in Adult Health Education.
4. Industrial Hygiene and Sanitation.

Discussion.

Luncheon Session—November 5—1 p.m.

HEALTH Service in Small Groups.

(This subject represents a problem which, although on the way to solution, remains in many instances a difficulty still unapproached.)

Discussion.

Afternoon Session—November 5—2:30 p.m.

SYMPOSIUM—THE ECONOMICS OF INDUSTRIAL HEALTH: What are the criteria to be used in estimating the worth of industrial health service? Are the tangible and intangible results of equal or different importance? What kind of data are the most favorably convincing?

1. Organization and Cost of a Health Service.
2. Does Health Service Pay the Employee?
3. Does Health Service Pay the Employer?
4. Does Health Service Pay the Public?

Discussion.

Dinner Session—November 5—6:45 p.m.

INDUSTRIAL Health, Defense, and the Private Practitioner.

(Three subjects which, combined, should be of vital interest to every practitioner and industrialist.)

(Open Forum to follow Speaker's Presentation.)

Morning Session—November 6—9:30 a.m.

SYMPOSIUM—THE SOCIAL IMPLICATIONS OF INDUSTRIAL HEALTH:

How far should industrial health service go? Are hospital and medical care plans related to industrial service in any practical way? Does legislation play a part in this problem? What of labor turnover increase, spoilage, lack of trained men?

1. What Does the Employee Want?
2. Management's Experience.
3. As the Industrial Physician Sees It.
4. The Insurance Carrier's Interest.

Discussion.

Luncheon Session—November 6—1 p.m.

THE problem of Women in Industry.

(Women in industry present problems not entirely limited to their physiologic functions.)

Discussion.

Afternoon Session—November 6—2:30 p.m.

PLANT Visits—By special arrangement with local industries—announcement and registration at each previous session.

Industrial Medicine

— in Medical Preparedness —

THE objectives of physical examination in industry should be to keep the worker fit, to place him in a job where he can do his best work without harm to himself or to his fellow workers, to detect communicable disease and to refer him to his own doctor for needed treatment. The handicapped worker should be rehabilitated.

The problems of industrial hygiene may be attacked from two angles: first, the hygiene of the individual and, second, the hygiene of the environment in which he works and lives. The first problem is a proper function of the medical sciences, while the working environment has to do largely with engineering practices. It is the province of the medical profession to diagnose diseases and primarily to recognize the existence of such diseases as may be due to the working environment. Based on the conclusions of the physician, the engineer learns what unhealthful conditions should be investigated and what control measures are to be initiated. It is essential, therefore, that the various professions understand clearly the functions of each and approach the solution of the problems of industrial hygiene as a joint effort and cooperate with one another to the fullest extent.

The medical problem may best be approached by grouping physicians in industry into full time industrial physicians and part time and on call physicians. Approximately 85% of workers are employed in small plants in which there are no organized medical services. Services to these industries are supplied by private practitioners including specialists in various fields, some of whom have made important contributions to industrial medicine. The medical departments of large industrial plants serve as models of efficiency and have demonstrated their worth. The problem confronted by these departments in large industries in the present emergency is largely one of expansion of existing facilities. The fact that medical service to 85% of our workers is predominantly in the hands of private physicians presents an important problem of coordination of effort. In large industries the relatively few full time men who are specialists in industrial medicine have engaged chiefly in measures for the prevention of occupational disease and the promotion of health. Opportunities of a like nature and probably on a larger scale exist in small manufacturing establishments and are available to physicians who render services to these plants.

—STANLEY J. SEEGER, M.D., in *J.A.M.A.*

Industrial Medicine
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Volume 10 August, 1941 Number 8

American Board

— of Industrial Medicine and Surgery —

AT THE Meeting of the A.M.A. Section on Preventive and Industrial Medicine and Public Health, at Cleveland, on June 4, DR. ROBERT T. LEGGE, Berkeley, California, read the following resolution which, at its Twenty-Sixth Annual Meeting in May, at Pittsburgh, had been adopted by the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS and presented to the A.M.A. Council on Industrial Health:

WHEREAS, there has been a marked increase in the number of physicians and surgeons devoting their services to the practice of industrial medicine and surgery; and

WHEREAS, the American Medical Association has recognized the importance of this special type of practice by the establishment of the Council on Industrial Health with its many diversified activities in this specialty field; be it

RESOLVED, that the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS recommend the appointment of a committee of three members of this Association to cooperate with a similar committee from the related section of the American Medical Association to further the establishment of an AMERICAN BOARD OF INDUSTRIAL MEDICINE AND SURGERY and to seek the approval for this AMERICAN BOARD OF INDUSTRIAL MEDICINE AND SURGERY by the Advisory Board for Medical Specialties.

DR. LEGGE said that the committee appointed by the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS was DRS. EDWARD C. HOLMBLAD, FREDERICK WILLIAM SLOBE, and VOLNEY S. CHENEY, all of Chicago.

DR. LEGGE moved that the resolutions be presented to the section for adoption. The motion was regularly seconded. The chairman suggested that the resolutions be referred to the executive committee to be referred back on the following day. The motion was put to a vote and was carried.

On the following day, June 5, DR. I. C. RIGGIN, Richmond, Virginia, reported for the executive committee, to which the resolutions presented by the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS at the Wednesday session were referred, recommending that the section cooperate and work with the Association and suggesting that the following members of the section be appointed by the chairman as a committee to work with the Association: DRS. LEVERETT DALE BRISTOL, New York; R. T. LEGGE, Berkeley, California; and W. A. SAWYER, Rochester, N. Y.

On motion made by DR. I. C. RIGGIN, it was voted that the section adopt a suitable resolution signifying its willingness and desire to cooperate with the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, and that the chairman of the section be authorized to appoint DRS. BRISTOL, LEGGE and SAWYER as a committee to represent the section in working with the Association.

Thus industrial medicine, which, only a little while ago, was pretty generally thought about as possible of specialty status only in the remote future, is well on its way toward full recognition *now*.

A. A. I. P. & S. Committees

THE standing committees of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, recently appointed by the President, DR. T. LYLE HAZLETT, appear on page 4. The list is complete with the exception of the 1941-1942 committee for the Knudsen Award, which will be announced later. DR. HAZLETT'S thought in determining the scope of the committee undertakings, and the selection of the personnel, is expressed as follows:

"In this period of national emergency the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS has a most outstanding responsibility as well as an opportunity never before presented not only to advise but also to engage in the field of research in all problems concerning the well-being of industrial workers. In order that our Association may be of more value to individual members as well as all component societies, we must create a more unified effort which will produce results in the application of medicine among our fellow workers in industry."

INDUSTRIAL HEALTH AND DISEASE

Industrial Chemistry and Morbidity

F. ALBERT DONLAN, M.D.,
Metuchen, New Jersey

THE extent of development regarding the adequacy of industrial hygiene in respect to the prevention of industrial hazards and diseases depends primarily upon the capacity and ability of specialized groups (notably chemical engineers and clinicians) to afford an endless exchange of scientific knowledge gained through experience and collaboration, and secondly, upon simplicity and uniformity of application. There can be no doubt of either the originality or the ability of the chemical engineer. Research in industry, by providing a veritable storehouse of knowledge, has proved that the difficulty has not been a lack of knowledge in respect to the opportunities to correlate clinico-chemical facts, but has been due to an indifference or inability so far as general interests are concerned in synchronizing, as it were, chemical equations clinically, immediately and with uniformity of application. When physicians in general become cognizant of the fact that progress in respect to preventive medicine depends as much, if not more, upon the capacity and ability of the chemical engineer as it does upon the biochemists, the sooner will opportunities for a more enlightened perspective become manifest.

Generally speaking, in industry there is a belated lack of correlation between the chemical engineers' laboratory and clinical studies in respect to practical application. There should be concerted efforts from the viewpoint of clinico-chemical correlation to show the bearing of conclusions in respect to the interpretations of disease or an effort to adopt the methods of laboratory investigation as they apply to morbid conditions arising from industrial exposures. There should be a more uniform attempt to emphasize physico-chemical principles underlying occupational exposures from the viewpoint of the industrial chemists, of importance in respect to human conservation. While there are examples of isolated groups of industrial engineers and clinicians who through cooperation have brought forth many valuable contributions to science, especially in respect to toxicology and medical jurisprudence, we are still too far away from a policy of unified interests in respect to human health needs. The chemical engineer grasps physiological and pathological problems quickly, perhaps because of his analytical foundation. Physicians, usually trained biologically, rarely possess an adaptation for industrial problems—due to the fact that too many cannot possibly appreciate the significance of industrial hygiene — because they lack basic training in industrial chemistry. The premedical training should be revised with due respect to this all important omission.

In respect to preventive medicine, as it relates to the practical application of industrial hygiene, the total efficiency in the fulfillment of a purpose will be heightened when individual efforts of specialized groups are well coordinated. Productivity of men already employed will increase

In *Medical Record*, July, 1941.

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through the abatement of idleness due to occupational factors resulting in an acceleration of efficiency and a better economy. Industrial managers are especially concerned in constructive efforts that further mutual interests from the viewpoint of realities rather than in procedures on the borderline of hysteria or "gunshot" expedients. Nothing is more encouraging to industry's interests than a community that is health conscious in respect to the employee who will cooperate and a county administration that will lend its full support without subordinating industry's interests. An industry affording competent chemical engineering facilities is especially equipped to further the best interests of preventive medicine as it relates to industry.

The most striking factor inhibiting industry's economic progress has always been the unknown coefficient of individual quality (capacity and ability) in respect to initiative, ambition, opportunity and intelligence. So also has been the problem of inescapable economic competition confronting the employer (whether in the open market or mandatory), inhibited initiative and the progress of individual enterprise. Many of the problems operative in industry inhibiting mutual welfare have been or are under existing policies beyond control because of such a wide range in differentials and the impossibility of harmonizing interests. Encouraging is the fact that irrespective of the multiplicity of differences, education and enlightenment seem to be shaping up for industry more hopeful attitudes which definitely indicate, on a basis of equity, a shift toward widespread harmony of interest. When a better attitude prevails in respect to industrial hygiene and the chemical engineer is generally regarded as an indispensable factor for original contributions and vigilance, clinical manifestations of success will become more obvious. Harmonizing problems of differentials is a difficult task. It is, nevertheless, an indispensable factor for any appreciable degree of social or economic gain.

In respect to the furtherance of preventive medicine as it relates to occupational hazards and diseases, the employee must be educated and trained to be self-reliant. The employee must be made conscious of the fact that success in any industrial program relative to industrial exposures and diseases will, to a large degree, depend upon individual appreciation of self-preservation—not in emergencies but in one's daily endeavors. Compulsive legislation has been a good disciplinarian serving as a check-rein for emotional difficulties, infractions, oppressions and omissions. However, with the knowledge experience affords regarding systems and procedures and the fact that employer and employee are more receptive to enlightenment and a policy of equity than formerly, there should be little difficulty in either becoming cognizant of the fact that a voluntary system of cooperation based on a coordinating mechanism will speed up interest and encourage the practical application of the principles of preventive medicine, primarily through mass education and secondly through a formidable policy regarding replacement and rehabilitation.

Statisticians allege that occupational diseases do not constitute the major cause of idleness. They say, on the contrary, that other causes do. Nevertheless, states a high insurance dignitary: "The true state of affairs regarding industrial diseases emphasizes the fact that past experiences in respect to the incidence of occurrence, pending legislation and difficulty of control justify and demand a policy of universal vigilance." Regarding predisposing causes of idleness associated in particular with given occupations, statisticians say nothing. They are: improper ventilation and temperature fluctuations, dampness, laborious physical efforts, crowding, poor sanitation, noxious odors and gases, acidulous fumes, skin irritants, faulty illumination, inadequate safety measures and failure to exclude communicable disease contacts. Statistics do not constitute a "yardstick" for computation as it relates to idleness based on the incidence of ill health. The realities of life cannot be successfully reduced to barren statistics. There can be no cohesiveness of either policy or purpose when too much reliance is placed upon statistics which are after all national averages. Statistics amount to little more than a means of qualifying or predicating industrial hazards and diseases from the viewpoint of insurance as it relates to "experience." By no means are they a barometer of the incident of occurrence of idleness due to impaired health.

Statistics do not reflect the implications of insidious exposures, whether chemical, gaseous, thermal, physical or bacteriological. Reliance upon statistics under such circumstances defeats incentive and originality, thereby discouraging concerted efforts toward the collaboration of all interests and especially the clinico-chemical necessary for the furtherance of preventive medicine. There is too much responsibility placed upon the medical "set-up" in respect to the elimination of substandards and the control of liability and not sufficient development in correlating facts through a program of industrial hygiene relative to prevention of occupational hazards.

Industry, as a benefactor, has a profound sociological significance. Fortunately for American workers most industrialists are honest and progressive men who understand the value of education toward the furtherance of a policy of economy and efficiency in a spirit of receptivity. The majority of industrialists now realizing the trend of public feeling in respect to occupational hazards and diseases willingly subscribe to a policy of public relations that is mutually beneficial.

Industry must be supported by a capable organization possessing incentive and originality that keeps it one step ahead in public relations. That is a task requiring a perpetual deviation from a routine and an aptitude for continuous efforts regarding self-preservation. There are too many industries who never change their tempo of indifference regarding a better social idea. Such omissions and iniquities incite public feeling, culminating in social legislation as a vindication of human rights when reason fails.

Stating that industrial hygiene is either an expedient or an expenditure worthwhile is not sufficient inducement for its widespread endorsement. In its fullest measure the science must function through the collaboration of an efficient coordinating mechanism, interdependent on allied sciences, interests and knowledge. Without these adjuncts, this function will remain haphazard, expensive and inefficient.

—Continued from page 12.

many of the old ones. Typical causes are (1) introduction of potentially dangerous chemicals new to the plant's experience; (2) stepping-up a hitherto safe process to the point where it becomes hazardous; (3) assignment of jobs involving risk to health to inexperienced workers; (4) vitality lowered by fatigue, with consequent inefficiency and absenteeism; (5) "short cuts" in employment, safety, and medical procedure due to failure of these services to keep up with physical expansion. The division furnishes chemical,

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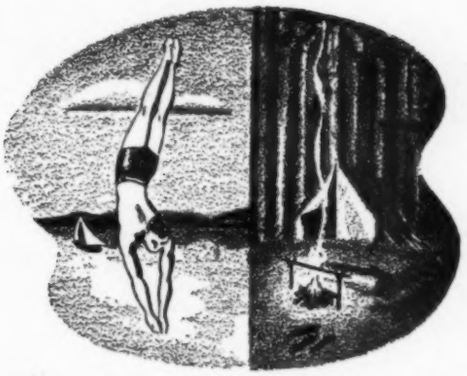
medical and engineering service to employers. Accompanying the bulletin are enclosures concerning important phases of industrial health activities. For example, there is a table of harmful substances commonly used in industry with their maximum concentrations which can be absorbed by the air in a plant without harm to the workers. Copies of material are available from MANFRED BOWDITCH, Director, Division of Occupational Hygiene, Massachusetts Department of Labor and Industries, Boston. — *Labor Standards*, May-June, 1941.

ACCORDING to WALTER WEST, executive secretary of the American Association of Social Workers, 45,000,000 persons in this country are underfed at this moment, and he thinks this state of affairs has much to do with the rejection on account of physical defects of "nearly half" of the men summoned for Army induction under the Selective Service Act.—*Medical Times*, July, 1941.

MORE physicians trained in industrial health and medicines are urgently needed, it was reported by DR. IRVIN ABELL, chairman of the Health and Medical Committee of the Federal Security Agency. The A.M.A.'s Council on Industrial Health has classified 9,557 doctors as having indicated special interest in or limitation of practice to industrial medicine.—*Medical Economics*, July, 1941.

DR. H. M. F. BEHNEMAN, San Francisco, in *J.A.M.A.*, points out that when the question arises as to whether a patient with heart disease or high blood pressure should be employed or rejected by an employer, there are five parties to be considered or who have to consider the question. These are the injured worker, the employer, the trade union, the insurance company, and the industrial physician. Of the first four, the workman naturally thinks he is fit to work, the trade union in its endeavor to protect the workman and his family thinks him fit, the employer is doubtful about employing him as he considers the history of these cases from the standpoint of efficiency, regular hours and mass production, and the insurance official wants to make a profit for his company without raising the employer's premium rates. As the fifth party—the industrial physician—is the only one who is not "directly" interested, DR. BEHNEMAN suggests that he should become thoroughly acquainted with the ef-



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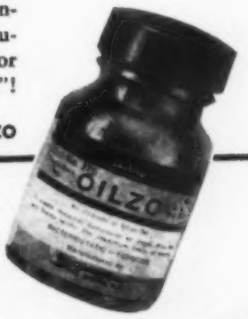

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Here is the summation of our knowledge of Poisons—brought up-to-date and compiled in a manner especially suited to the needs of the Medical Profession. In this book Dr. McNally, one of the foremost authorities in this country on Toxicology, covers in detail the origins, properties and physiological action of poisons, and their treatment and detection. Cyclopaedic in its scope, and meticulous in its handling. No Industrial Physician can afford to be without this valuable reference book.

The Author — WM. D. McNALLY, M.D.

Dr. McNally has had 25 years of experience as specialist consultant in Toxicology. Univ. Mich., 1901-05; Univ. Ill., 1905-06; 1916-17; M.D. Rush Med. Coll., 1930; Post-grad., Vienna, 1935; at present, physician, chemist and medico-legal consultant in majority of poison murder cases today.

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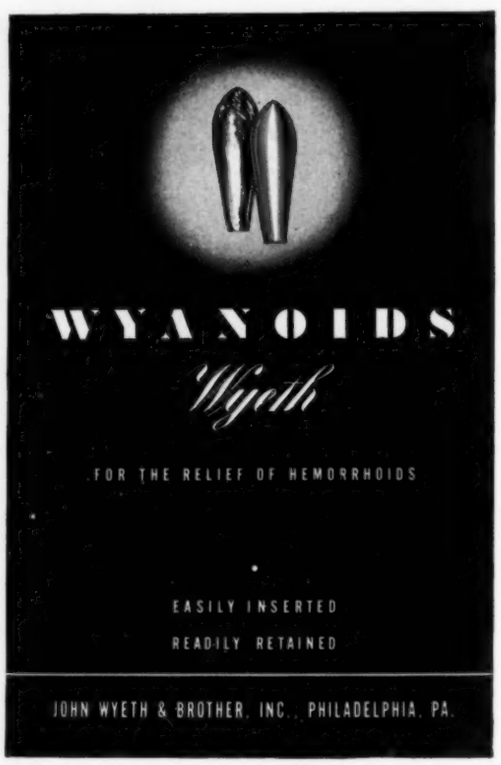
fect of work—effort—and of emotional disturbances upon heart disease and high blood pressure. Some suggestions are: (1) Establishment of an institute where a worker with these diseases finds out how much work he can do safely. This protects worker and employer. (2) Establish wider use of electrocardiograph in examination of workers. (3) Give the disabled worker prompt and proper medical care. Don't discard him but develop him and cooperate with bureaus which find work for disabled persons in skilled or unskilled labor. (4) Create legislation enabling persons with heart disease to work under medical supervision, yet releasing employer and insurance company of liability. Certainly a worker with heart disease or high blood pressure, and also his family, are going to be happier if he is allowed to work than if left to worry at home.—DR. JAMES W. BARTON, in *Chicago Daily News.*

DR. C. F. YEAGER, Medical Supervisor of the Remington Arms Company, addressed the Twelfth Annual Convention and Exposition of the Greater New York Safety Council, Inc. Emphasizing that the destiny of the United States depends greatly upon the production of its factories, he pointed out that "increased production under the national defense program is creating many new problems for industrial medicine. Workers are being called upon to drop their usual routines and take up activities to which they are unaccustomed. New mechanical operations are replacing the old. New processes, involving many new compounds, are being introduced. Industrial medicine is expanding to meet the emergency. It has already proved its worth in normal times, but now it needs the united assistance of scientists, engineers, doctors, nurses, public health authorities, welfare, and many others." Reviewing the development of industrial medicine from its origin with the surgeon who was retained to treat workers after they had been injured, he emphasized that industrial medicine today is chiefly preventive medicine. "Its scope can be judged by the basic objectives laid down for it by the American College of Surgeons. These include ascertaining by examination the physical and mental fitness of employees for work; maintaining and improving the health and efficiency of those already employed; and educating the worker in accident prevention and personal hygiene. . . . Industrial medicine provides reasonable first aid and advice for employees suffering from non-occupational disabilities, but above all a cooperative relationship is maintained with the family physician. By his detailed examinations and knowledge of the employee's work, the industrial physician is able to give invaluable assistance by acting as investigator and adviser for the family physician. The industrial physician can help alleviate the shortage of skilled workers by scientifically evaluating the capabilities of those who hitherto have been unemployed for physical disabilities."

APROPOS of new mechanical operations replacing the old, and new processes involving many new compounds being introduced, one industrial hygiene engineer remarks that "already there are some 256 items on the Priorities List, and all indications point to the fact that many more items will be added in the near future"; while another says: "We are finding the increased use of lead as a substitute for zinc." No doubt this, as Cap'n Henry used to say, is "Only the beginning!"



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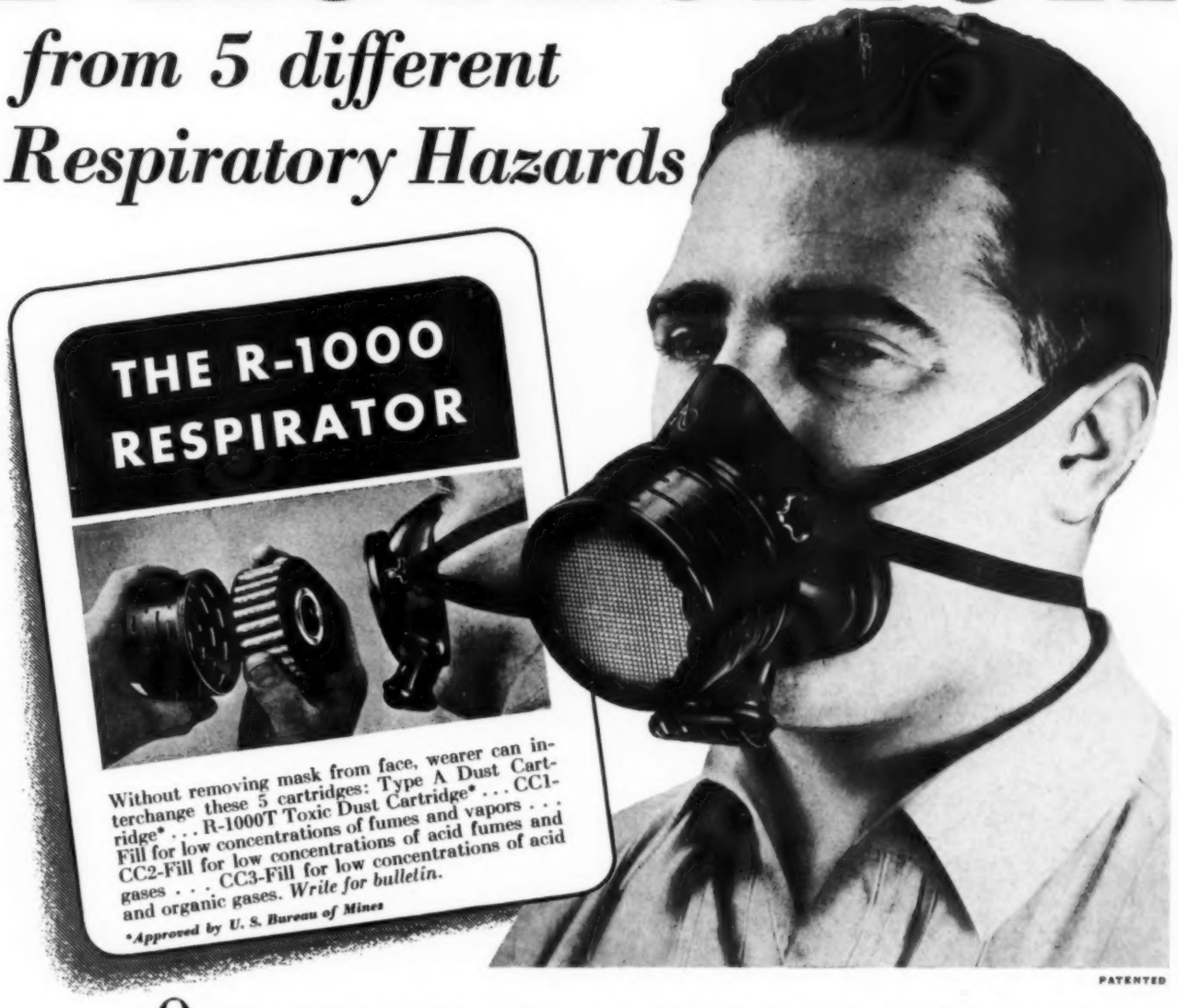
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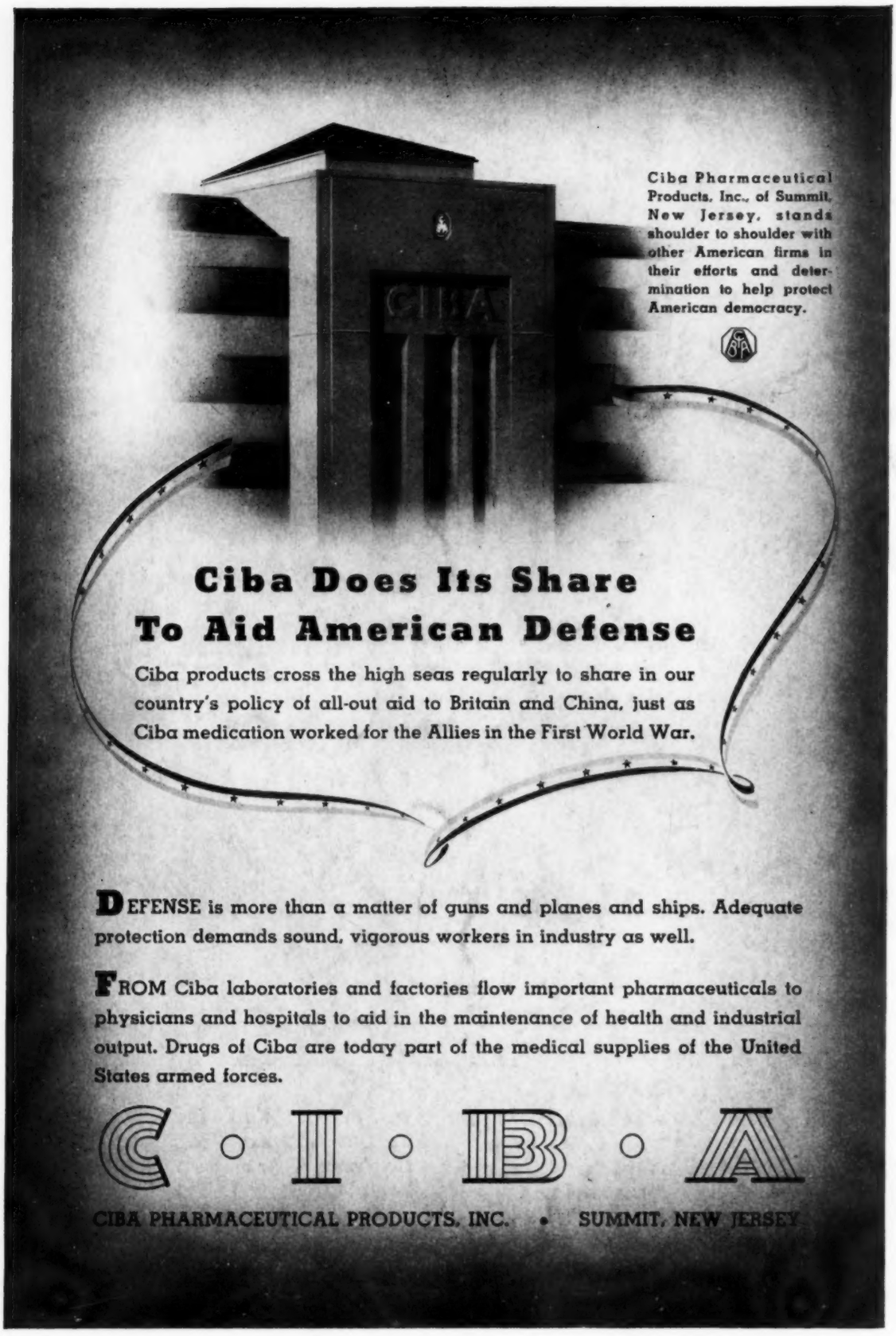

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